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A LIGHTNING RADIOGRAPH.

BY R. K. DUNCAN.

For some time accounts have appeared in various scientific publications and the daily press of a method by which shadowgraphs might be obtained by the aid of X rays without the use of any Crookes tube.

W. D. Crumbie, of New York, obtained a fine impression of a Columbian silver coin by placing it in a plate-holder and exposing it to an electric discharge between two brass plates. He thereupon announced in the *Evening Post* that he had discovered a new method by which X rays might be induced.

Dolbear, of Tufts College, next stated that he also had obtained an impression of an object by placing it in the plate-holder, between the terminals of a Holtz machine, and, according to the newspapers, that he, and he alone, was deserving of all the credit that had gone to Roentgen, for it seems he had accomplished this feat some years before.

In England, Lord Blytheswood obtained impressions of objects by exposing the covered plate-holder to the electro-magnetic field of a large Wimshurst machine. He also found that he could obtain these impressions without exposing the plate-holder to the direct discharge of the machine, but that any part of the electro-magnetic field was efficacious. So far as the experimental work is concerned, I have verified the results of these gentlemen, but, unfortunately for their theory as to the X rays, I have obtained in each case a positive impression of the object and not a true shadowgraph at all.

In the verification of Crumbie's experiment I noticed great brushes radiating out from each side of the impression, showing clearly that it was due to the electrical discharge.

In exposing the coin to the electro-magnetic field outside the direct discharge I obtained a clear impression of the coin down to the finest detail, but since the coin was covered with a heavy watch glass, and since, in addition, glass is impermeable to X rays, the action could not surely have been accomplished by their aid.

A most important corroboration of my contention has recently come to me from Auburn, N. Y., in the shape of a very remarkable negative. This negative was taken last year by Mr. W. Tabor, of Auburn, and was sent to me by Mr. G. S. Reynolds, of the same place.

At first glance it is a common-place negative enough—that of a horse and carriage and a mass of shrubbery—but a closer inspection brings out the somewhat remarkable fact that the word "exposed" is printed in inverted order across the body of the horse.

A Lightning Radiograph.

Now, the word "exposed," as everybody interested in photography knows, is printed on the slide of every plate-holder. Before exposure the slide is placed with the lettering inside, and after exposure outside, obviously to tell one whether he has used the plate or not.

Mr. Reynolds writes me that either before or after the exposure the plate-holder, with its contents, was exposed to the lightning flash from a coming thunder-storm. After development, to his surprise, the lettering was found on the negative as stated.

Now, is this result so surprising after all? The lightning flash is but the Holtz machine discharge in its grandest and most magnificent form, and this experiment, unconsciously carved out, is but what we might have expected from the known conditions. At the moment of the flash we evidently had the whole space for miles around permeated by electro-magnetic waves of the utmost intensity, and we might, therefore, fairly expect the effect to be instantaneous. The corroboration of my statement that such effects can not be due to X rays lies in the fact that we have here an indubitable print of the lettering and not a blank shadow, such as we should certainly have from the action of X rays.

Electric Railway Work in Ohio.

The Dayton Traction Company, of Dayton, Ohio, have contracted with Stern & Silverman, of Philadelphia, Pa., for the building of their line from Dayton to Miamisburg, Ohio, a distance of 12 miles. The contract calls for the furnishing of the roadbed complete with bridges, cars, trucks and motors, Corliss engines, boilers, dynamos, and the erection of steel and brick car-barn and power station, all to be in operation by July 1, 1896.

Changed His Mind Quickly.

The following was received by the General Electric Company, written on a postal card:

Boston, Mass., December 18, 1895.

Dear Sir—Will you be so Kind as to send me a Ca'alogue free of all Expenses By Post Prepaid, and oblige

P. S.—I have changed my mind so Please Do not send it.

ON THE SENSITIVENESS OF CERTAIN SALTS TO THE X RAY.

BY THOMAS A. EDISON.

As I have previously stated, well crystallized tungstate of calcium made by the fusion process is extremely sensitive to the Roentgen ray. The next best fluorescing salt is tungstate of strontium, made in the same manner. Tungstate of barium or lead does not appreciably fluoresce. There are a number of other salts and minerals which fluoresce. The following is a list: Subchloride of mercury, mercury diphenyl, cadmium iodide, sulphide calcium, potassium bromide, tetrametaphosphate of lead, potassium iodide, mercurous chloride, bromide lead, sulphate lead, fluorite, powdered lead glass, pectolite, sodium cressotinate, ammonia salicylate, calcium salicylate, salicylic acid. The following are salts which fluoresce less: Powdered German glass, barium fluoride, calcium fluoride, sodium fluoride, sodium chloride, mercuric chloride, cadmium chloride, silver chloride, lead chloride, lead iodide, sodium bromide, cadmium, lithia bromide, mercury, cadium sulphate, uranium sulphate, uranium phosphate, uranium nitrate, uranium acetate, molybdic acid, silicate of potash dry, sodium bromide, wulfenite, orthoclase andalucite, herdinite, pyromorphite, apatite, calcite, danburite, calcium carbonate, strontium acetate, sodium tartrate, barium sulphobenzoic, calcium iodide, true and artificial ammonium benzoic. It is anomalous that rock salt, being practically transparent to radiant light and heat, should powerfully absorb the X ray and give strong fluorescence.

Further experiments with the fluorescence of different chemicals under the influence of the X ray have

added a few more to the list already mentioned. The following fluoresce: Cadmium tungstate, tungstate of zinc, lithia benzoate, tannate of lead, carbonate of lead, salicylate of potassium, carbonate of silver, sodium salicylate, sodium carbonate, sodium tungstate, zinc acetate, zinc chloride, zinc carbonate, molybdate of zinc, benzoic acid, malic acid, diphenylamine, ruffigallic acid, pyridin nitrate.

I have, so far, found no salt of the following metals to fluoresce: Aluminum, antimony, arsenic, borax, beryllium, bismuth, cerium, chromium, cobalt, copper, gold, iridium, magnesium, manganese, nickel, tin, titanium.

The crystals of the following chemicals give spots of light when held close to the bulb within a dark box. The light has the glow worm color of phosphorescence and is due to the electric discharge and not to the X ray: Ammonium sulphocyanide, calcium formate, calcium nitrate, iron citrate, silver nitrate, soda lime, zinc cyanide, zinc hypermanganate, zinc valerianate.

With plates of fluorite I have found that the phosphorescence penetrates the plate very slowly. If held before a fluorescing tube for one minute the phosphorescence penetrates for one-sixteenth of an inch deep in the plate. This part, when held edgewise, is brilliant; beyond is dark.

A dry plate (photographic) does not fluoresce to the eye when submitted to the X ray in a dark box, although nearly all the crystals of silver salts fluoresce.

EDISON'S FLUOROSCOPE.

A DEVICE THAT PROMISES TO BE OF GREAT VALUE TO THE MEDICAL PROFESSION.

After much exhaustive experimenting, Thomas A. Edison has developed a device which, in its ultimate state of evolution, promises to be of very great value to the medical profession, especially to surgeons. He calls it the "fluoroscope." By means of it, in conjunction with a Crookes tube, the whole interior economy of the human body may be made visible to the eye. Mr. Edison admits that at present the fluoroscope is probably in a crude state; even so, the results accomplished with it are marvelous.

The fluoroscope consists of a light-tight pasteboard box, painted black inside, with tapering sides and a square, flat end. At the smaller end is a leather piece edged with plush braid. This leather piece is so shaped that when held to the face the eyes are free to look into the box toward the larger end, and all light is excluded. The box is about a foot long and is equipped with a handle as well as a strap passing around the head, which may be used to hold it tightly to the eyes in case the operator desires the use of both hands. The flat end of the box is about six inches square. The interior face of this end is coated with crystals of calcium tungstate in the following manner: The pasteboard is first covered with white paper, which is afterward coated with collodion. Fine crystals of calcium tungstate are sifted on the collodion, and then coarser ones, until the surface is smoothly and completely covered with a thin coating of the crystals. The end is then attached to the box.

By holding a human hand between the fluoroscope and a Crookes tube, and looking through the opening for the eyes, the bones of the hand may be distinctly seen. The fluorescence of the calcium tungstate apparently changes the rays from the Crookes tube into ordinary light after they have passed through the hand, thus making the bones visible to the human eye.

In speaking of his experiments in fluorescence, Mr. Edison said last Saturday to a representative of the ELECTRICAL REVIEW:

"After trying over 1,800 different salts I have found 72 that fluoresce. The best of these is tungstate of calcium; but as I am still continuing my work in this direction, I may find

EDISON'S FLUOROSCOPE.

something even better. With the fluoroscope in its present state, and using a current of four amperes, I can see perfectly the interior of the hand. If I can get Crookes tubes to stand eight amperes of current, I hope with a large fluoroscope to be able to see the whole of the body. If I hold my hand close to the tube the rays seem to pass through bones and all and I can see nothing. Six inches from the tube the bones come out strong and clear and there is no image of the flesh. About a foot away from the tube the flesh is visible, and a faint outline of the hand can be seen eight feet from the tube."

"Can you detect the circulation of the blood at any distance from the tube?" the REVIEW man inquired.

"No, the blood is not visible. I expect to arrange a set of apparatus in compact form for use in hospitals. The tube, induction coil and batteries to supply current will be placed in an inclosed wooden box. A patient with a broken or diseased limb will place the affected member on top of the box, and a physician with a fluoroscope can then see at a glance any abnormal conditions.

"Say, this thing is all right for doctors, but looking at the inside of my hand makes me sick. Br-r-r!" and Mr. Edison shuddered in disgust.

"Have you formed any idea of the nature of the X ray?" was asked.

"Not even a remote idea. Don't know a thing about it. Why, look here. We've been working with ordinary light for 300 years, and see how little we know about it. We've been working hard on electricity for 100 years and we know nothing about it. How are we going to know anything about the X ray after only six weeks' work?"

AN INTERVIEW WITH ROENTGEN.

A VISIT TO HIS LABORATORY IN WURZBURG.

Mr. H. J. W. Dam, of London, formerly of New York, where he was well known in electrical circles, was recently commissioned by cable from the enterprising publisher of *McClure's Magazine*, of New York, to visit Professor Roentgen at Wurzburg and interview him in relation to his latest discovery. Through the courtesy of *McClure's* we are privileged to give the interview below:

Professor Roentgen entered hurriedly, something like an amiable gust of wind. He is a tall, slender and loose-limbed man, whose whole appearance bespeaks enthusiasm and energy. He wore a dark blue sack suit, and his long, dark hair stood straight up from his forehead, as if he were permanently electrified by his own enthusiasm. His voice is full and deep, he speaks rapidly, and, altogether, he seems clearly a man who, once upon the track of a mystery which appealed to him, would pursue it with unremitting vigor. His eyes are kind, quick and penetrating; and there is no doubt that he much prefers gazing at a Crookes tube to beholding a visitor, visitors at present robbing him of much valued time. The meeting was by appointment, however, and his greeting was cordial and hearty. In addition to his own language he speaks French well and English scientifically, which is different from speaking it popularly. These three tongues being more or less within the equipment of his visitor, the conversation proceeded on an international or polyglot basis, so to speak, varying at necessity's demand.

It transpired, in the course of inquiry, that the professor is a married man and 50 years of age, though his eyes have the enthusiasm of 25. He was born near Zurich and educated there, and completed his studies and took his degree at Utrecht. He has been at Wurzburg about seven years, and had made no discoveries which he considered of great importance prior to the one under consideration. These details were given under good-natured protest, he failing to understand why his personality should interest the public. He declined to admire himself or his results in any degree, and laughed at the idea of being famous. The professor is too deeply interested in science to waste any time in thinking about himself. His emperor had *fêted*, flattered, and decorated him, and he was loyally grateful. It was evident, however, that fame and applause had small attractions for him, compared to the mysteries still hidden in the vacuum tubes of the other room.

"Now, then," said he, smiling, and with some impatience, when the preliminary questions at which he chafed were over, "you have come to see the invisible rays."

"Is the invisible visible?"

"Not to the eye, but its results are. Come in here."

He led the way to the other square room mentioned and indicated the induction coil with which his researches were made—an ordinary Rhumkorff coil, with a spark of from four to six inches, charged by a current of 20 amperes. Two wires led from the coil, through an open door, into a smaller room on the right. In this room was a small table carrying a Crookes tube connected with the coil. The most striking object in the room, however, was a huge and mysterious tin box, about seven feet high and four feet square. It stood on end, like a huge packing case, its side being perhaps five inches from the Crookes tube.

The professor explained the mystery of the tin box, to the effect that it was a device of his own for obtaining a portable dark room. When he began his investigations he used the whole room, as was shown by the heavy blinds and curtains so arranged as to exclude the entrance of all interfering light from the windows. In the side of the tin box, at the point immediately against the tube, was a circular sheet of aluminum one millimetre in thickness, and perhaps 18 inches in diameter, soldered to the surrounding tin. To study his rays the professor had only to turn on the current, enter the box, close the door, and in perfect darkness inspect only such light or light effects as he had a right to consider his own, hiding his light, in fact, not under the Biblical bushel, but in a more commodious box.

"Step inside," said he, opening the door, which was on the side of the box farthest from the tube. I immediately did so, not altogether certain whether my skeleton was to be photographed for general inspection, or my secret thoughts held up to light on a glass plate. "You will find a sheet of barium paper on the shelf," he added, and then went away to the coil. The door was closed, and the interior of the box became black darkness. The first thing I found was a wooden stool, on which I resolved to sit. Then I found the shelf on the side next the tube, and then the sheet of paper prepared with barium platino-cyanide. I was thus being shown the first phenomenon which attracted the discoverer's attention and led to the discovery; namely, the passage of rays, themselves, wholly invisible, whose presence was only indicated by the effect they produced on a piece of sensitized photographic paper.

A moment later the black darkness was penetrated by the rapid snapping sound of the high-pressure current in action, and I knew that the tube outside was glowing. I held the sheet vertically on the shelf, perhaps four inches from the plate. There was no change, however, and nothing was visible.

"Do you see anything?" he called.

"No."

"The tension is not high enough;" and he proceeded to increase the pressure by operating an apparatus of mercury in long vertical tubes acted upon automatically by a weight lever which stood near the coil. In a few moments the sound of the discharge again began, and then I made my first acquaintance with the Roentgen rays.

The moment the current passed the paper began to glow. A yellowish-green light spread all over its surface in clouds, waves, and flashes. The yellow-green luminescence, all the stranger and stronger in the darkness, trembled, wavered, and floated over the paper, in rhythm with the snapping of the discharge. Through the metal plate, the paper, myself, and the tin box, the invisible rays were flying, with an effect strange, interesting, and uncanny. The metal plate seemed to offer no appreciable resistance to the flying force, and the light was as rich and full as if nothing lay between the paper and the tube.

"Put the book up," said the professor.

I felt upon the shelf, in the darkness, a heavy book, two inches in thickness, and placed this against the plate. It made no difference. The rays flew through the metal and the book as if neither had been there, and the waves of light, rolling cloudlike over the paper, showed no change in brightness. It was a clear, material illustration of the ease with which paper and wood are penetrated. And then I laid book and paper down and put my eyes against the rays. All was blackness, and I neither saw nor felt anything. The discharge was in full force, and the rays were flying through my head, and, for all I knew, through the side of the box behind me. But they were invisible and impalpable. They gave no sensation whatever. Whatever the mysterious rays may be, they are not to be seen, and are to be judged only by their works.

I was loath to leave this historical tin box, but time pressed. I thanked the professor, who was happy in the reality of his discovery and the music of his sparks. Then I said: "Where did you first photograph living bones?"

"Here," he said, leading the way into the room where the coil stood. He pointed to a table on which was another—the latter a small, short-legged, wooden one with more the shape and size of a wooden seat. It was two feet square and painted coal black. I viewed it with interest. I would have bought it, for the little table on which light was first sent through the human body will some day be a great historical curiosity; but it was "nicht zu verkaufen." A photograph of it would have been a consolation, but for several reasons one was not to be had at present. However, the historical table was there, and was duly inspected.

"How did you take the first hand photograph?" I asked.

The professor went over to a shelf by the window, where lay a number of prepared glass plates, closely wrapped in black paper. He put a Crookes tube underneath the table, a few inches from the under side of its top. Then he laid his hand flat on the top of the table, and placed the glass plate loosely on his hand.

"You ought to have your portrait painted in that attitude," I suggested.

"No, that is nonsense," said he, smiling.

"Or be photographed." This suggestion was made with a deeply hidden purpose.

The rays from the Roentgen eyes instantly penetrated the deeply hidden purpose. "Oh, no," said he; "I can't let you make pictures of me. I am too busy." Clearly the professor was entirely too modest to gratify the wishes of the curious world.

"Now, Professor," said I, "will you tell me the history of the discovery?"

"There is no history," he said. "I have been for a long time interested in the problem of the cathode rays from a vacuum tube as studied by Hertz and Lenard. I had followed theirs and other researches with great interest, and determined, as soon as I had the time, to make some researches of my own. This time I found at the close of last October. I had been at work for some days when I discovered something new."

"What was the date?"

"The eighth of November."

"And what was the discovery?"

"I was working with a Crookes tube covered by a shield of black cardboard. A piece of barium platino-cyanide paper lay on the bench there. I had been passing a current through the tube, and I noticed a peculiar black line across the paper."

"What of that?"

"The effect was one which could only be produced, in ordinary parlance, by the passage of light. No light could come from the tube, because the shield which covered it was impervious to any light known, even that of the electric arc."

"And what did you think?"

"I did not think; I investigated. I assumed that the effect must have come from the tube, since its character indicated that it could come from nowhere else. I tested it. In a few minutes there was no doubt about it. Rays were coming from the tube which had a luminescent effect upon the paper. I tried it successfully at greater and greater distances, even at two metres. It seemed at first a new kind of invisible light. It was clearly something new, something unrecorded."

"Is it light?"

"No."

"Is it electricity?"

"Not in any known form."

"What is it?"

"I don't know."

And the discoverer of the X rays thus stated as calmly his ignorance of their essence as has everybody else who has written on the phenomena thus far.

"Having discovered the existence of a new kind of rays, I of course began to investigate what they would do." He took up a series of cabinet-sized photographs. "It soon appeared from tests that the rays had penetrative power to a degree hitherto unknown. They penetrated paper, wood, and cloth with ease; and the thickness of the substance made no perceptible difference, within reasonable limits." He showed photographs of a box of laboratory weights of platinum, aluminum, and brass, they and the brass hinges all having been photographed from a closed box, without any indication of the box. Also a photograph of a coil of fine wire, wound on a wooden spool, the wire having been photographed and the wood omitted. "The rays," he continued, "passed through all the metals tested, with a facility varying, roughly speaking, with the density of the metal. These phenomena I have discussed carefully in my report to the Wurzburg society, and you will find all the technical results therein stated." He showed a photograph of a small sheet of zinc. This was composed of smaller plates soldered laterally with solders of different metallic proportions. The differing lines of shadow, caused by the difference in the solders, were visible evidence that a new means of detecting flaws and chemical variations in metals had been found. A photograph of a compass showed the needle and dial taken through the closed brass cover. The markings of the dial were in red metallic paint, and thus interfered with the rays, and were reproduced. "Since the rays had this great penetrative power, it seemed natural that they should penetrate flesh, and so it proved in photographing the hand, as I showed you."

A detailed discussion of the characteristics of his rays the professor considered unprofitable and unnecessary. He believes, though, that these mysterious radiations are not light, because their behavior is essentially different from that of light rays, even those light rays which are themselves invisible. The Roentgen rays can not be reflected by reflecting surfaces, concentrated by lenses or refracted or diffracted. They produce photographic action on a sensitive film, but their action is weak as yet, and herein lies the first important field of their development. The professor's exposures were comparatively long—an average of 15 minutes in easily penetrable media, and half an hour or more in photographing the bones of the hand. Concerning vacuum tubes, he said that he preferred the Hittorf, because it had the most perfect vacuum, the highest degree of air exhaustion being the consummation most desirable. In answer to a question, "What of the future?" he said:

"I am not a prophet and I am opposed to prophesying. I am pursuing my investigations, and as fast as my results are verified I shall make them public."

"Do you think the rays can be so modified as to photograph the organs of the human body?"

In answer he took up the photograph of the box of weights. "Here are already modifications," he said, indicating the various degrees of shadow produced by the aluminum, platinum, and brass weights, the brass hinges, and even the metallic stamped lettering on the cover of the box, which was faintly perceptible.

"But Professor Neusser has already announced that the photographing of the various organs is possible."

"We shall see what we shall see," he said. "We have the start now; the developments will follow in time."

"You know the apparatus for introducing the electric light into the stomach?"

"Yes."

"Do you think that this electric light will become a vacuum tube for photographing, from the stomach, any part of the abdomen or thorax?"

The idea of swallowing a Crookes tube, and sending a high frequency current down into one's stomach, seemed to him exceedingly funny. "When I have done it, I will tell you," he said, smiling, resolute in abiding by results.

"There is much to do, and I am busy—very busy," he said in conclusion. He extended his hand in farewell, his eyes already wandering toward his work in the inside room. And his visitor promptly left him; the words, "I am busy," said in all sincerity, seeming to describe in a single phrase the essence of his character and the watchword of a very unusual man.

Professor Pupin on the Fluoroscope.

TO THE EDITOR OF ELECTRICAL REVIEW:

Messrs. Aylsworth and Jackson, of East Orange, N. J., presented me, on behalf of Mr. Thomas Alva Edison, with a tungstate of calcium fluoroscope. It is a magnificent piece of apparatus and will undoubtedly prove of the greatest service in the new field of work opened up by Roentgen's discovery. I can not speak too highly of its merits, and I take much pleasure in recommending it to all who are interested in Roentgen radiance. I wish to state also that this recommendation is spontaneous and not in any way suggested or even hinted at by the generous donors.

Mr. Edison and his assistants, Messrs. Aylsworth and Jackson, deserve the deepest gratitude on the part of scientific men and the public at large for their magnificent fluorescent screens. Yours, etc.,

M. I. PUPIN,

Columbia College, New York, March 28.

Edison's Most Important Work.

Champ Mathewson, son of Principal Mathewson, of the Milford, Ct., High School, wrote Mr. Edison, asking him what he considered his greatest invention, and in reply received the following letter:

FROM THE LABORATORY OF THOMAS A. EDISON,
ORANGE, N. J., March 20, 1896.
"PHONOGRAPHIC DICTATION."

C. W. MATHEWSON, Esq.,
Milford, Ct.

DEAR SIR: In reply to your favor of the 13th inst., I beg to state that I consider the incandescent light system my greatest invention.

Yours truly, THOMAS A. EDISON.

Mr. H. D. Stanley has associated himself with Mr. W. R. Brixey, and in the future will make his headquarters at 203 Broadway with the Kerite company. Mr. Stanley is widely known in the electric wire business, having recently resigned as manager of the New York office of the National India Rubber Company, of Bristol, R. I.

Brill Electric Cars for Cape Town, South Africa.

The accompanying illustrations show exterior and interior views of one type of electric cars forming part of an order which the J. G. Brill company, of Philadelphia, has recently finished for Cape Town, South Africa. Fig. 1 represents the outside view of one of the cars, 22 feet long in body. They are finished inside in ash and cherry natural finish and handsomely varnished. The seating capacity of these cars is 64 passengers—32 below and 32 above—and the seats are all arranged transversely of the car, as shown in Fig. 2. The car is mounted on Eureka maximum traction pivotal trucks and equipped with Westinghouse No. 38 50-horse-power motors. The seats are Hale & Kilburn make. The inside of the lower deck is ceiled with three-ply veneer, handsomely decorated. The windows are double sash, top sash stationary, lower sash arranged to drop. The car has a stairway at both ends and suitable platform projection, accommodating the motorman, controller and brake apparatus outside of the step landing. This represents the largest car furnished to the Cape Town company. The order also includes a closed car of smaller type, which measures 17 feet six inches long over all, which has a seating capacity for 50 passengers. The car is identically the same finish as that shown in the illustrations, and is mounted on Brill No. 21C non-pivotal electric motor-trucks.

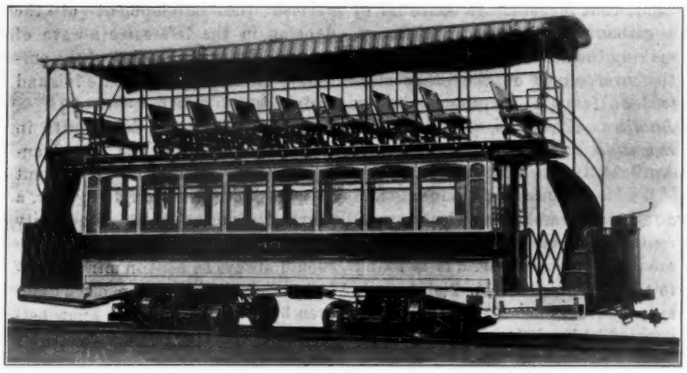


FIG. 1.—BRILL DOUBLE-DECK, DOUBLE-TRUCK ELECTRIC CAR FOR CAPE TOWN, SOUTH AFRICA.

The J. G. Brill company furnished a still smaller type of car to the Cape Town company, which was practically the same as the above, excepting that it was 14 feet six inches long, and with seating capacity for 44 passengers. These are the first electric motor cars which this company has built having double decks and transverse seats, the usual practice being to run a row of seats longitudinally of the car body, back to back, through the center with aisles on both sides. By the method shown the seating capacity of the roof is materially increased.

The J. G. Brill company furnished the power plant complete, being an equipment of three 300-horse-power Philadelphia Engineering Works's vertical tandem compound condensing engines and Westinghouse multipolar generators; three 300-horse-power boilers; Westinghouse switchboard; supply pumps; economizer and live steam purifier. The pipe work was all designed in the Brill company's office.

FIG. 2.—INTERIOR VIEW OF BRILL ELECTRIC CAR FOR CAPE TOWN, SOUTH AFRICA.

TELEPHONE NEWS AND COMMENT.

President F. M. Murphy, of the Santa Fe, Prescott & Phœnix Railroad, is reported to have sold the telegraph line of the company to the Postal Telegraph Cable Company, which will at once take charge. The line is said to be in first-class condition and 200 miles long.

The directors of the American Bell Telephone Company on March 16 declared the regular quarterly dividend of three per cent, payable April 15. The total of dividends last year was 15 per cent, extras of one and one-half per cent being declared June 12 and December 11.

The city of Wichita, Kas., has granted an exclusive five-year franchise to the Missouri & Kansas Telephone Company. The rates the company agreed to allow in that city, although the franchise does not name them, are $36 per annum for business houses and $30 for residences. Manager Chipchase, the local manager of the company, is much elated over the outcome.

The Select Council of Philadelphia has voted in favor of the ordinance granting to the Standard Telephone Company the privilege of establishing an exchange in that city. The ordinance provides for free telephone service in all public buildings and offices, including the high and normal schools and one school building in each section; that the company shall pay the city three per cent of its gross receipts; that within 90 days from the passage of the ordinance the company shall file its plans, and that it shall have expended at least $200,000 for materials or work within a year from the approval of the plans; that the company shall within a year be equipped to give service to 2,000 telephones.

THE HISTORY OF ELECTRIC HEATING APPLIED TO METALLURGY.

READ BEFORE THE WASHINGTON SECTION OF THE AMERICAN CHEMICAL SOCIETY BY FREDERIC P. DEWEY.

(*Continued from page 161.*)

From this time on for over 30 years nothing seems to have been done in electric heating, although there were a few applications of the current to metallurgical processes in connection with external or other heat, such as the English patents No. 9,946, of 1843, to A. Wall for the use of the current in the blast furnace, and No.

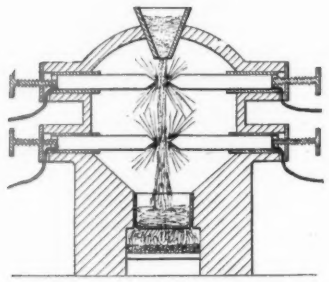


FIG. 1.—PICHON'S ELECTRIC FURNACE.

10,362, of 1844, and No. 10,684, of 1845, to Napier for treating copper ore by the current in crucibles.

In 1848 and 1849 Despretz published a series of articles in which he described the effect of combining the heat from three different sources—the electric current, the blowpipe and a burning glass. He clearly illustrates the difference between temperature and quantity of heat, the great difference there may be in the temperature of the source of heat and the temperature attained by the material heated, and that the loss of heat from the material heated may be supplied by a source of heat at a comparatively lower temperature and allow a higher temperatured source of heat to exert its full heating effect. Thus, on heating magnesia by the current at his command, it simply became pasty; but on adding to this the heat of the burning glass, it immediately volatilized in white fumes.

He determined that it is easier to volatilize carbon than to melt it; also that lime, magnesia and oxide of zinc behave in the same way. He melted alumina to a transparent glass; he also melted titanic acid in various forms, oxide of iron and disthen.

He suggested the use of the current for melting metals practically, and melted 80 grams of palladium and 250 grams of platinum.

In his last communication Despretz described an arrangement in which a quantity current was passed through his crucible while a separate series current was passed through the contents.

In 1849 an English patent No. 12,772 was granted to Staite & Petrie, in which the current was applied to the treatment and fusion of iridium.

In 1853 an English patent No. 5 was granted to Watson & Prosser for the use of the current in converting iron into steel, by which the time of conversion was to be shortened and the quality of the steel improved. In one case the current was passed through the inclosing trough, and in another the poles were put into the cementing material surrounding the bars. These propositions seem to resemble some of the modern ideas of producing heat, but it is not clear that Watson & Prosser used sufficient current to produce any considerable heating effect.

Although I have not yet been able to locate the exact date, I mention here the Grove furnace, which has been called the prototype of the incandescent furnace. It consisted of a carbon crucible set in mercury, making the current connection, while the cover served as the other electrode. It was mentioned in *La Lumiere Electrique*, 19, 350, and *Scientific American* Supplement, April 24, 1886.

We come now to the first real attempt to employ the electric current to heat and act upon a charge of ore in a practical way. It is found in the invention of M. Pichon, patented in France March 16, 1853, covered by English patent No. 700, of 1853. In this process iron or other ores are mixed with carbon and shaken down between two or more pairs of electrodes, through which the current is passing, when it melts, and after which it drops into an externally heated receptacle below.

The description of this furnace, Fig. 1, in *Practical Mechanics' Journal*, speaks of the electrodes as being very large, but I think that feet should be read inches.

In 1854 Duvivier placed a piece of disthen in the electric flame and produced globules of metal.

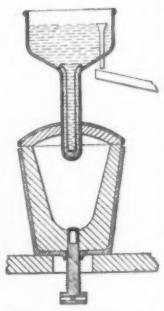


FIG. 2.—SIEMENS' FURNACE.

There is another long break after 1854 in our subject, strictly speaking, although there were many metallurgical propositions in which the current was employed, but they were either wet processes, or else flame heat was employed.

In 1866 Le Roux published an exceedingly interesting and suggestive, but all too brief, communication upon the action of the arc upon lime and strontia. He decomposed lime and strontia in the arc and studied the reactions spectroscopically. He determined that the metals, calcium and strontium, were reduced, and carefully distinguished between the spectrum of the metals themselves and the spectrum of the white light resulting from the incandescence of the oxides. He asks the questions: Is the separation of the metals the result of electro-chemical decomposition? Is it due to vapor of carbon? Is it due to disassociation from heat alone? But he does not answer them.

We have seen that up to this time considerable work of a scientific character had been done from time to time in the field of dry electro-metallurgy, and that some suggestions at least had been made for the practical application of the current in this field. Undoubtedly, however, the cost of the current at this time was prohibitive. In looking over the field we can see the germs of modern processes, and easily imagine that if the early workers had been supplied with cheap current they would have carried their work very much farther, and developed practical metallurgical processes of value; but it remains as a fact that they did not have cheap current, and did not invent modern electric metallurgy.

With the development of the dynamo in the 70's came a wave of activity in the application of the current to metallurgy in the late 70's and early 80's.

Before considering this growth in detail it is well to look at the advantages to be derived from the current as a heating agent. In doing this, a sharp distinction between quantity of heat and degree of temperature should always be kept in mind. Unfortunately these terms are often used, even by persons who really know better, and who thereby mislead those who do not know better, as if they were synonymous. This is not at all the case. We may have an enormous quantity of heat developed at a low degree of

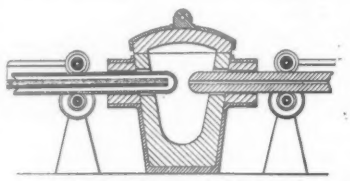


FIG. 3.—SIEMENS' FURNACE.

temperature, of which the pile of rotting apples is the old and familiar example. On the other hand, we may have a very high temperature developed by a small quantity of heat. A good blowpiper can melt fine platinum wire in a small blowpipe flame. While the combustion of a given quantity of fuel will always supply the same quantity of heat, the temperature developed may vary enormously. When we carry this consideration farther and apply it to the practical application of heat, this difference becomes much more marked and pronounced. For instance, a mixture of iron ore and carbon may be supplied with any quantity of heat at a low temperature without reducing the metal; or a mixture of bar iron and carbon may be heated indefinitely to a low temperature without producing steel, but, once the proper degree of temperature is reached, the required reactions take place. On the other hand, the proper temperature once attained, a sufficient quantity of heat at the right temperature must be supplied to carry on operations. While the good blowpiper can readily melt a fine platinum wire in his flame, yet he can not even soften a stout laboratory rod of platinum.

In practical work we are further limited by materials of construction, their fusibility, their heat conduction and radiation.

The temperature attainable by ordinary combustion is limited by the temperature of disassociation of carbon and oxygen, which has been put at 2,500 degrees to 2,600 degrees Centigrade; but at such temperatures combustion is slow and losses of heat large, so that the practically attainable flame furnace temperature is probably about 1,800 degrees to 2,000 degrees Centigrade, while the practical oxyhydrogen blowpipe temperature may be several hundred degrees higher; but where the flame must not come in contact with the materials under treatment, and the heat must pass through the walls of a crucible or muffle, we must be content with a very much lower temperature.

With the electric current the conditions are changed. The first and most striking factor is the enormous temperature that can be both experimentally and practically reached. What the maximum temperature attainable may be has not yet been established, but temperatures about 3,800 degrees Centigrade have been measured by Moissan and Violle. The second factor is that the heat can be developed right at the point where it is utilized, and the losses reduced to the minimum. This is especially advantageous in replacing muffle and crucible heating, as is also the fact that the heat is secured without the introduction of enormous quantities of products of combustion. Again, the temperature is under most perfect control, and can be adjusted with the utmost nicety. There are also minor advantages in the cleanliness and compactness of the operations.

It remains, however, that the cost of the current limits its practical application even now to a few special cases, and this is likely to remain so until the dream of the electrician of converting coal directly into current be realized.

In 1875 an English patent No. 4043 was issued to G. L. Fox for heating a crucible by the heat generated by resistance to the passage of the current, but, curiously enough, his resistance material was placed outside his crucible, and the heat had still to pass through the walls of the crucible.

In 1878 a voluminous French patent No. 122,227 was issued to M. Repieff, in which arrangements of electrodes for electric furnaces are shown. In the electric light part of his patent he also uses oxides to color his light.

In 1878 an English patent No. 4,650 was issued to Clarke & Smith for producing ammonia by passing a mixture of nitrogen and hydrogen through sufficiently prolonged white heat produced by the electric arc.

The next electric furnace was that described in the celebrated English patent No. 2,110, of May 27, 1879, to C. W. Siemens. This may be said to inaugurate the era of electric furnaces proper, and to be the first real, hearty and systematic attempt to make practical use of heating by the current.

As described in the patent with all its attendants of water-cooled electrodes and regulating devices, it is a formidable and elaborate piece of apparatus, but divested of its accessories its real operating parts become simply a crucible provided with two electrodes, arranged either vertically (Fig. 2) or horizontally (Fig. 3), through which the current passes.

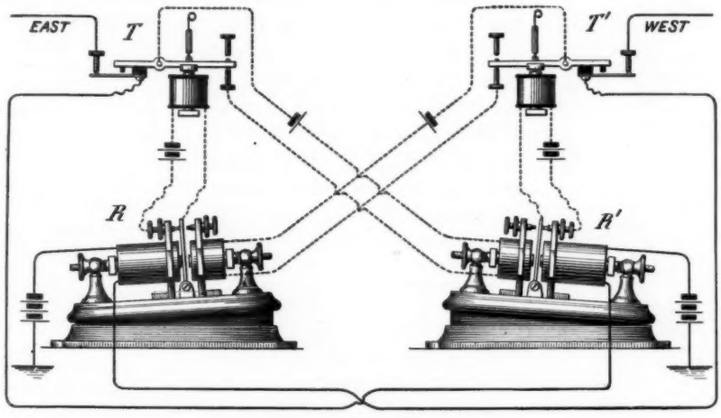
This apparatus was described and exhibited in actual operation before the Society of Telegraph Engineers and the British Association. The descriptions and exhibitions were confined for the most part to simple melting operations, although some attempts to saturate iron with carbon are described. It does not appear that Siemens ever used his furnace for the reduction of metals, although the article in *Iron* suggests that it might be so used. The death of Siemens undoubtedly cut off work in that direction with this apparatus.

(*To be continued.*)

Horton's Telegraph Repeater.

Mr. L. Horton, Jr., superintendent of the Philadelphia & Reading Railroad Company's telegraph system, has recently been granted letters patent on a telegraph repeater, which has found great favor among telegraph men generally on account of its simplicity, compactness and effective working, and which has already been adopted by the Lehigh Valley Railroad, Philadelphia & Reading Railroad and National Transit Company, and is in use on the lines of the Western Union Telegraph Company, American Telephone and Telegraph Company, North American Telegraph Company and Pennsylvania lines west of Pittsburgh.

The distinguishing feature of this repeater is the method adopted for preserving the continuity of the sending circuit while the opposite line is being repeated into, which Mr. Horton accomplishes in a remarkably simple and effective manner by the utilization of the force of gravity, dispensing with all extra armatures, springs or other mechanical contrivances, the holding force being obtained by the withdrawal instead of the application of a local current.



HORTON'S TELEGRAPH REPEATER.

The principle and operation of the repeater will be readily understood by reference to the accompanying illustration in which T and T' are ordinary repeater transmitters of the usual form with front and rear contacts arranged for repeating into their opposite lines, and also for actuating the retracting magnets of opposite relays.

R and R' are main line relays differing from the ordinary relay only in the inclined base and the addition of the local retracting magnets, which are placed directly behind the relay armature, occupying the same relative position as the main line magnets in front, and acting, when energized, upon the armature as a retractile force (in place of the usual spring) to draw it backward and away from its local contact when the main line current through the front coils is interrupted; and when demagnetized to prevent such movement of the armature, which, under this condition, remains motionless upon its front or local contact, regardless of the presence or absence of a current through the main line coils in front, the inclined base on which the relay rests causing the armature to retain its forward position by the force of gravity at such times as both sets of coils may be demagnetized, and thus keep its neighboring transmitter closed.

These retracting magnets, being adjustable with reference to their position with the armature, are drawn toward or away from the latter, as it is desired, to increase or diminish their force upon it, in precisely the same manner as the tension of the spring in the ordinary relay is regulated; and it will be seen that this is the only part of the repeater requiring adjustment.

The arrangement of circuits, as shown in the diagram, is as follows: The eastern circuit is brought to the post of the transmitter T, and from there, when the transmitter is closed, through relay R' to battery and ground. The western circuit is brought to the post of transmitter T', and thence through relay R to battery and ground.

Both lines being represented as closed, the action of the repeater is as follows:

A distant office on the western line opening its key interrupts the current through relay R, the armature of which is thereupon drawn away from its local contact by the action of its retracting magnet, permitting its neighboring transmitter T to open, which in turn opens first the local circuit of retracting magnet of relay R' and next the eastern circuit at its spring contact.

The opening of the extra local circuit demagnetizes the retracting magnet, thereby preventing any movement of the armature of relay R', which is held against its front or local contact stop by its own weight when the main line through the front coils is opened an instant later, transmitter T' being thus kept closed, preserving the local circuit through retracting magnet of relay R, and providing a path for the western circuit through spring contact of transmitter T', relay R and battery to ground, to enable the distant western office to close relay R again.

When the western office closes its key the armature of relay R is again attracted, closing the local circuit of transmitter T, which in turn closes first the eastern circuit at its spring contact and next the local circuit of relay R's retracting magnet.

The means employed for keeping the relays on either side closed during the time their respective circuits are being repeated into, accomplishes the result most effectively without the use of extra armatures requiring special adjustment, the adjustment being thus simplified to that of an ordinary relay.

The advantages of this repeater over other forms are:

1. Its thorough efficiency as a repeater—the absence of all extra armatures and springs from the relay rendering the latter extremely sensitive, and permitting the closest possible adjustment of both relay and transmitter armatures, the play of which may be shortened up so that their motion is scarcely perceptible, which, together with the instantaneous application of the holding force, greatly increases the capacity of the repeater for rapid work. Any very marked decrease in strength of extra local current, which is fatal to the operation of most forms of repeaters, can be instantly and fully compensated for in this instrument by simply giving the adjustment screw of the retracting magnet a turn to bring it closer to the armature, and as the holding force is in no sense dependent upon the strength of current, any variation in the same can have no possible effect upon this function of the instrument.

2. The very small amount of attention required during its operation—the adjustment seldom requiring change; and the ease and simplicity of adjustment, which insures better results in the hands of ordinary operators than other forms.

3. Small amount of battery required with resultant economy in maintenance—one cell of extra local for each retracting magnet being sufficient as against six cells usually employed in the Milliken, in addition to which it is found that the transmitters can be operated on less battery consequent upon their close adjustment. It is safe to say that a saving of about 10 cells of local battery can be effected at each repeater where this form takes the place of a Milliken repeater.

It will be readily seen that this repeater can be divided into half sets and operated in connection with duplex or quadruplex systems with the same facility as other forms not possessing the advantages of this.

Mr. Edwin S. Reid.

Mr. Edwin S. Reid, who has been with the Standard Underground Cable Company for many years as superintendent of construction, has severed his connection with that company and has accepted a position with the National Underground Cable Company, with main office at New York and branch offices at Chicago, Philadelphia and Boston, as its general superintendent of construction, and all construction work done by the National company will be under his immediate charge and supervision.

Mr. Reid, who was for many years associated with Mr. Stephen D. Field in his various electrical works, entered the underground cable business in its earliest days, and many of the appliances used on underground cable work which have tended to make underground cables successful are of his invention and design.

The well known Reid cable terminal, which was invented by him only a few years ago, has given such satisfaction, and met the requirements of the users so well, that over 100,000 of them are in use to-day in the United States and Canada on telephone, telegraph and electric light cables for underground and aerial service.

There are but few underground systems in the United States which Mr. Reid has not had something to do with, and his experience covers not only the construction of cables, but also the building of complete subway systems.

Mr. Reid has already started in on his work with the National Underground Cable Company, and in the hands of one so competent the most satisfactory results are certain to be obtained.

The National company is certainly surrounding itself with the most competent men obtainable, and is to be congratulated upon its enterprise and progressiveness.

Electric Light Plant for Tully, New York.

The village of Tully, a small place of 600 inhabitants, located 20 miles south of Syracuse, N. Y., has purchased and is placing an electric light system. The poles and cross-arms are already delivered and the poles are being set. Power will be furnished by an Ames Iron Works Company's high-speed engine, located in the same building with the village waterworks system. The boilers will be of sufficient capacity to furnish an automatic high-speed engine and the pumps for the village water system. The dynamo was purchased from the Fort Wayne Electric Corporation and is an alternating machine of 1,000 lights capacity. Eighteen arc lamps will be placed in the streets, and it is expected that nearly the capacity of the machine will be taken up by consumers in stores and residences. Mr. J. A. Henry, of the Fort Wayne Electric Corporation, is superintending the placing of the machine and the circuits, and it is expected that the plant will be in operation by May 1.

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***CHANGES** for advertisements must be in this office by Friday noon for the following week's issue. NEW ADVERTISEMENTS should be in the office not later than Saturday noon to insure publication the following week.*

NEW YORK, APRIL 1, 1896.

CONTENTS.

	PAGE
A Lightning Radiograph	165
Electric Railway Work in Ohio	165
Changed His Mind Quickly	165
Edison	165
Edison's Fluoroscope	166
An Interview With Roentgen	166
Professor Pupin on the Fluoroscope	167
Edison's Most Important Work	167
Brill Electric Cars for Cape Town, South Africa	167
Telephone News and Comment	167
The History of Electric Heating Applied to Metallurgy	168
Horton's Telegraph Repeater	169
Mr. Edwin S. Reid	169
Electric Light Plant for Tully, N. Y.	169
Tesla's Latest Contribution to Science	170
The Financial Side	170
Tesla on Reflected Roentgen Rays	171
Roentgen Rays	172
The Metropolitan Telephone and Telegraph Company's New Building	173
National Electric Light Association	173
Lundell Fan Motors	174
The National Electrical Exposition	174
Advance Information	175
Kindred Interests	ix
Electrical Patents	x
American Institute of Electrical Engineers	x
Personal	x
Industrial Notes	x

INDEX OF ADVERTISERS.

COVER PAGES.

	PAGE
Abendroth & Root Mfg. Co., boilers	xvi
American Electrical Works, insulated wire	i
Armington & Sims, engines	xvi
Beacon Lamp Co., incandescent lamps	i
Bishop Gutta Percha Co., wires and cables	xvi
Bogart, A. L., electric gas-light specialties	i
Bristol Co., recording voltmeters, etc	i
Bunnell & Co., J. H., dry batteries	i
Day's Kerite, insulated wire	i, viii
Eastern Electric Cable Co., wires and cables	xvi
Electric Appliance Co., supplies	i
Goubert Manufacturing Co., heaters	xvi
Greeley, The E. S., & Co., electrical supplies	i
Hampson, E. P., & Co., engines	xvi
Interior Conduit and Insulation Co., Lundell dynamos and motors	i, ii
Lombard Water Wheel Governor Co	xvi
McKenney & Waterbury, lamps and fixtures	i
Morris, Tasker & Co., tubes, poles, etc	xv
Okonite Co., insulated wire	i, xvi
Partridge Carbon Co., motor and generator brushes	i
Roebling's, John A., Sons Co., lead-encased cables	xvi
Safety Insulated Wire and Cable Co	i
Standard Paint Co., "Ship" carbon	i
Stewart, F. H., & Co., knife switches	i, ix
Stirling Co., water tube boilers	xvi

INSIDE PAGES.

	PAGE
Addystone Pipe and Steel Co	v
American Bell Telephone Co	xiii
American Electric Telephone Co., long-distance telephones	xiii
Baker & Co., platinum	ix
Ball & Wood Co., engines	iii
Baxter, H. E., & Co., electrical supplies	viii
Bi-Metallic Electric Transmission Co., bi-metallic wire	ix
Brady, T. H., Brady mast-arms	vii
Brill, J. G., Co., railway cars	viii
Brixey, W. R., Day's kerite wires and cables	viii
Central Electric Co., electric railway supplies	iii
Clark Telephone and Construction Co	x
Connecticut Pipe Mfg. Co	iv
Consolidated Telegraph and News Co	xiii
Correspondence School of Technology	ix
Current Literature Publishing Co	vii
Cutter Electric and Mfg. Co	vii
Dickinson Electric Supply Co., sign lamps	176
Diehl & Co., electric fans	iii
Dixon, Jos., Crucible Co., belt dressing	xii
Duval, E. S., Jr., patents	x
Dyer & Driscoll, patent solicitors	x
Empire China Works, porcelain specialties	xiv
Eppenger & Russell Co., Valentine subway electrical conduit	v
Faraday Carbon Co., carbons	xi
Fisher Electrical Mfg. Co	iv
Fleming, W. H., woven wire dynamo brushes	xiv
"For Sale."	ix
Fort Wayne Electric Corporation, "Wood" apparatus	v
Garvin Machine Co	vii
General Electric Co., electric light supplies	vii
Gordon-Burnham Battery Co	xiii
Hano, Philip, & Co., modern methods	xiv
Harrisburg Foundry & Machine Co., Harrisburg ideal engines	iii
Homer, F. E., & Co., commutators	xiv
Hooven, Owens & Rentschler Co., electric railway and electric light engines	iii
Huebel & Manger, bells, push buttons, etc	ix
International Correspondence Schools	176
Jewell Belting Co	xi
Keystone Telephone Co	xiii
Leffel, Jas., & Co., water wheels	vii
Lehigh Valley Creosoting Co., creosoted lumber	vii
Locke, Fred M	vii
Manhattan Electrical Supply Co., Mesco battery	ix
Marshall, Wm., condensers	v
Mason-Maxwell Telephone Mfg. Co	xiii
McIntire, C., Co., The, connectors and terminals	vii
Metropolitan Electric Co	xii
Metropolitan Telephone and Telegraph Co	x
Mianus Electric Co., telephones and electric supplies	xiii
Moore, Alfred F., insulated electric wire	xi
Morrison Southern Electric Co	xiv
Mutual Life Insurance Co	176
National Underground Cable Co	vi
New England Electric Supply Co., electrical supplies	176
New England Engineering Co	viii
New York Belting and Packing Co., rubber belts	xiv
New York Electric Co., incandescent lamps	176
New York Insulated Wire Co	xiii
Ostrander, W. R., & Co., supplies	vii
Partrick & Carter Co., electrical supplies for housework	ix
Phillips Insulated Wire Co., wire	ix
Phœnix Glass Co, globes, shades, etc	vii
Phœnix Interior Telephone Co	xii
Read, Robt. H., patents	x
Replogle Governor Works	xi
Royce & Marean, electrical supplies	ix
Rushmore, S. W., search-lights	ix
Safety Car Heating and Lighting Co., Pintsch system	iv
Schoonmaker, A. O., India mica	ix
Scientific Machinist Co., home study	ix
S. K. C. Specialty Co	xiv
Solar Carbon and Mfg. Co., carbon specialties	xiv
Standard Thermometer Co., arc lamps	vi
Stanley Electric Mfg. Co., S. K. C. two-phase system	xi
Syracuse Storage Battery Co	vi
"The American."	xiii
Tuerk Water Meter Co	v
U. S. Mineral Wool Co., copper caskets	176
Viaduct Mfg. Co., telephones, etc	xiii
Warren, A. K., & Co	xi
Wells Mfg. Co., files	vii
Western Electric Co., supplies	vi
Westinghouse Electric & Mfg. Co	v
Weston Electrical Instrument Co., measuring instruments	viii
White-Crosby Co., contracting engineers	vii
Whitney Electrical Instrument Co	vii

Homer certainly nodded when the New York *Sun* printed the following: "* * * The observer sees on the phosphorescent end a shadow picture or Roentgenograph of his bones * * *." As an example of word building, "Roentgenograph" is an abomination.

The enterprising New York daily that heralded to the world the "original scientific discovery" in Edison's laboratory (at which the reporter modestly assisted) of the possibility of seeing through opaque substances, should ponder on these words from Edison:

> Roentgen, you know, didn't discover the rays. They were discovered years ago by Lenard and others, so there was nothing really new about them. But what Roentgen discovered was that this ray would pierce opaque bodies and would photograph and fluoresce on platino-cyanide of barium. That was new and interesting.

One of the most pleasing phases of the large amount of experimenting done in this direction is the prompt recognition awarded to Roentgen's work by such eminent men as Edison, Tesla, and Thomson. In no instance has any American scientist attempted to appropriate Roentgen's thunder.

Mr. Edison's recent researches on the fluorescence of metallic salts are briefly but interestingly described by him in an article on another page of this issue of the ELECTRICAL REVIEW. He has reached at least one practical result in the development of a device which he calls the fluoroscope. This promises to be of the greatest value in hospital practice, as it reveals instantly what it would require an hour or more to show by means of a radiograph. For urgent cases requiring an immediate operation, the fluoroscope gives the medical profession an advantage they have never before possessed—namely, the ability to see an abnormal or diseased condition of parts of the human body.

TESLA'S LATEST CONTRIBUTION TO SCIENCE.

We publish in this issue a communication from Mr. Tesla, which is even more interesting and important than his previous contributions presented in our columns. After announcing the extraordinary results obtained by means of his apparatus, which speak for the correctness of his conclusions regarding the character of the radiations, and after proving in crucial tests the long-sought-for property of reflection, he makes known a result which will probably lead to one of the most important realizations in science. His investigations of the reflective power of conductors disclose a singular relationship which seems capable of leading us to a deeper insight into the primary condition of matter than we have ever been able to obtain heretofore. Why is zinc, for instance, which is one of the first in Volta's electric contact series, one of the best reflectors? asks Tesla. Evidently such can only be the case if these mysterious rays emanating from the bulb convey matter in its primary state or condition. Let us hope that soon the full light of day will illuminate these obscure but immensely promising fields.

THE FINANCIAL SIDE.

Depression in business influenced a decline in the values of securities last week, and thus a number of important failures, higher money rates, inability of manufacturers and merchants to make collections, to realize on stocks or to borrow without paying usurious rates, afforded a basis for a bear campaign that culminated on Monday in a three-point decline in stocks. Subsequently there was a partial recovery due to the covering of short contracts. Political unrest abroad and the probability of gold exports in the immediate future checked a demand for securities other than those offered by the bears. As a consequence, dullness was a characteristic feature of the late trading. One very noticeable factor was the positive refusal of *bona fide* owners of securities to part with them at current prices. In fact, the stock market is the only avenue for investment open to capital at this time that does not involve considerable risk. This is why those who have a position therein refuse to abandon it.

Trade reviews indicate that the immediate future is largely dependent upon the weather. That there is a good volume of business is evidenced by the increases in bank clearings and railroad earnings, but it is largely in the West. For example, railroad earnings thus far in March record increases of 3.4 per cent over the corresponding period of 1895. The trunk lines decreased 3.4 per cent and other eastern roads 14.8 per cent, while the Grangers increased 23.2 per cent and other western and Pacific lines 12.9 per cent.

In electrical stocks there was very little of more than passing interest. General Electric shared in the general weakness. There is an old adage in Wall street in effect that the "stock tape tells the story." If this be accepted it refutes the ideas of the electrical bear organ that General Electric and Westinghouse, through their recently formed patent pool, have secured a copper-riveted cinch on the electrical industry. The price of General Electric dropped from 36⅜ on Monday to 34⅜ on Tuesday, and subsequently recovered 1 point. This movement hardly indicates the possession of a monopoly. I am told that the new agreement will not be put into effect until June 1. The delay is said to be due to the large number of details to be arranged. There is no doubt but that the stock is being steadily bought by insiders. Its future, however, from a standpoint of value, depends very largely upon the action taken in correcting the capital impairment.

An event of unusual interest to the electrical financial world was the declaration by the Postal Telegraph Company of its first dividend. It was one per cent, payable April 15, to stock of record April 4, out of earnings for the quarter ended December 31. I understand that quarterly payments will be made hereafter. The net earnings of the company have heretofore been applied to extensions and betterments. In

1895 they were $617,837; in 1894, $596,581. In 1886, the date of reorganization, there was a net loss of $29,711. Thus in less than 10 years the company has developed into a formidable competitor to the Western Union. Nor does it stand alone in this respect. There is Bell Telephone, which pays 15 per cent on stocks, and spends nearly as much more in extensions; and Commercial Cable, which pays 7 and earns 12. The capitalization of these three concerns is $46,500,000, or something less than one-half of that of Western Union. Referring to this competition and the stability of Western Union stock, a disgruntled bear was heard to remark last week that he did not believe investors would sell out even if Tesla should invent a system of communication through mother earth that would enable every man to be his own telegraph operator.

The financial center paid very little attention to the American Electrical Heating Corporation, formed in Boston this week. I understand that the stock is to be put upon the market, and when this is done it will be time to look into its value. The corporation will undoubtedly do for the electrical heating field what the formation of the Electric Storage Battery Company is doing for the storage branch of the industry.

This latter corporation, by the way, is coming rapidly to the front despite the fact that its development is still in embryo. Almost weekly it is making important contracts and is steadily extending its field of usefulness. The price of the stocks indicates that dividends are a considerable distance off.

Of the inactive electrical securities, American Telegraph and Cable sold at 93 and 94. Edison Electric Illuminating of New York sold a fractional lot at 98½. The old bonds sold at 106, the new ones at 102¾.

Mexican Telegraph Company has declared a quarterly dividend of 2½ per cent, payable April 16. The surplus earnings for the quarter, after the dividend, will be $33,794; total surplus, $483,937.

On the Boston Exchange, Bell Telephone advanced 1 point to 204. New England Telephone was steady at 90. This latter company has declared a quarterly dividend of 1¼ per cent, payable May 16 to stock of record April 30. Books reopen May 4. Westinghouse securities were steady at 30 @ 31 for the common, and 52½ bid, 53½ asked, for the preferred. The latter has declared a quarterly dividend of 1¾ per cent, payable April 1 to stock of record March 24. Books reopen April 1. Erie Telephone was unchanged at 59½. General Electric preferred weakened slightly in sympathy with the common stock in the New York market, touching 68½. Only about 150 shares were traded in during the week. In Philadelphia, Electric Storage common lost 1¼ and the preferred a similar amount. Pennsylvania Heat, Light and Power showed only fractional change and closed at 10½. BAIN.

New York, March 28.

TESLA ON REFLECTED ROENTGEN RAYS.

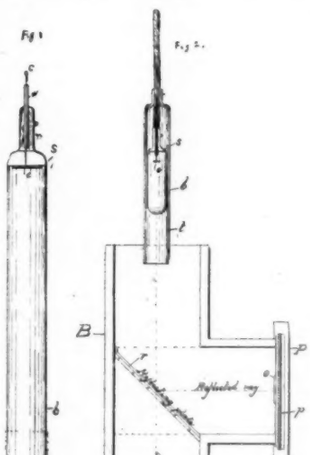
TO THE EDITOR OF ELECTRICAL REVIEW:

In previous communications to your esteemed journal in regard to the effects discovered by Roentgen, I have confined myself to giving barely a brief outline of the most noteworthy results arrived at in the course of my investigations. To state truthfully, I have ventured to express myself, the first time, after some hesitation and consequent delay, and only when I had gained the conviction that the information I had to convey was a needful one; for, in common with others, I was not quite able to free myself of a certain feeling which one must experience when he is trespassing on ground not belonging to him. The discoverer would naturally himself arrive at most of the facts in due time, and a courteous restraint in the announcement of the results on the part of his co-workers would not be amiss. How many have sinned against me by proclaiming their achievements just as I was good and ready to do it myself! But these discoveries of Roentgen, exactly of the order of the telescope and microscope, his seeing through a great thickness of an opaque substance, his recording on a sensitive plate of objects otherwise invisible, were so beautiful and fascinating, so full of promise, that all restraint was put aside, and every one abandoned himself to the pleasures of speculation and experiment. Would but every new and worthy idea find such an echo! One single year would then equal a century of progress. A delight it would be to live in such age, but a discoverer I would not wish to be.

Amongst the facts, which I have had the honor to bring to notice, is one claiming a large share of scientific interest, as well as of practical importance. I refer to the demonstration of the property of reflection, on which I have dwelt briefly.

Having had opportunities to make many observations during my experience with vacuum bulbs and tubes, which could not be accounted for in any plausible way on any theory of vibration as far as I could judge, I began these investigations—disinclined, but expectant to find that the effects produced are due to a stream of material particles. I had many evidences of the existence of such streams. One of these I mentioned, describing the method of electrically exhausting a tube. Such exhaustion, I have found, takes place much quicker when the glass is very thin than when the walls are thick, I presume because of the easier passage of the ions. While a few minutes are sufficient when the glass is very thin, it often takes half an hour or more if the glass be thick or the electrode very large. In accordance with this idea I have, with a view of obtaining the most efficient action, selected the apparatus, and have found at each step my supposition confirmed and my conviction strengthened.

A stream of material particles, possessing a great velocity, must needs be reflected, and I was therefore quite prepared—assuming my original idea to be true—to demonstrate sooner or later this property. Considering that the reflection should be the more complete the smaller the angle of incidence, I adopted from the outset of my investigations a tube or bulb *b* of the form shown in Fig. 1. It was made of very thick glass, with a bottom blown as thin as possible, with the two obvious objects of restricting the radiation to the sides and facilitating the passage through the bottom. A single electrode *e*, in the form of a round disk of a diameter slightly less than that of the tube, was placed about an inch below the narrow neck *n* on the top. The leading-in conductor *c* was provided with a long wrapping *w*, so as to prevent cracking, by the formation of sparks at the point where the wire enters the bulb. It was found advantageous for a number of reasons to extend the wrapping a good distance beyond the neck, on the inside and outside as well, and to place the seal-off in the narrow neck. On other occasions I have dwelt on the employment of an electrostatic screen in connection with such single-terminal bulbs. In the present instance the screen was preferably formed by a bronze painting *s*, slightly above the aluminum electrode and extending to just a little below the wrapping of the wire, so as to allow seeing constantly the end of the wrapping. Or else a small aluminum plate *s*, Fig. 2, was supported in the inside of the bulb above the electrode. This static screen practically doubles the effect, as it prevented all action above it. Considering, further, that



FIGS. 1 AND 2.—ILLUSTRATING TESLA'S EXPERIMENTS ON REFLECTED ROENTGEN RAYS.

the radiation sideways was restricted by the use of a very thick glass and most of it was thrown to the bottom by reflection, as I then surmised, it became evident that such a tube should prove much more efficient than one of ordinary form. Indeed, I quickly found that its power upon the sensitive plate was very nearly four times as great as that of a spherical bulb with an equivalent area of impact. This kind of tube is also very well adapted for use with two terminals by placing an external electrode e_1 as indicated by the dotted lines in Fig. 1. When the glass is taken thick the stream is sensibly parallel and concentrated. Furthermore, by making the tube as long as one desired, it was possible to employ very high potentials, otherwise impracticable with short bulbs.

The use of high potentials is of great importance, as it allows shortening considerably the time of exposure, and affecting the plate at much greater distances. I am endeavoring to determine more exactly the relation of the potential to the effect produced upon the sensitive plate. I deem it necessary to remark that the electrode should be of aluminum, as a platinum electrode, which is still persistently employed, gives inferior results, and the bulb is disabled in comparatively short time. Some experimenters might find trouble in maintaining a fairly constant vacuum, owing to a peculiar process of absorption in the bulb, which has been pointed out early by Crookes, in consequence of which, by continued use, the vacuum may increase. A convenient way to prevent this I have found to be the following: The screen or aluminum plate *s*, Fig. 2, is placed directly upon the wrapping of the leading-in conductor *c*, but some distance back from the end. The right distance can be only determined by experience. If it is properly chosen, then, during the action of the bulb, the wrapping gets warmer, and a small bright spark jumps from time to time from the wire *c* to the aluminum plate *s* through the wrapping *w*. The passage of this spark causes gases to be formed, which slightly impair the vacuum, and in this manner, by a little skillful manipulation, the proper vacuum may be constantly maintained. Another way of getting the same result in a tube shown in Fig. 1 is to extend the wrapping so far inside that, when the bulb is normally working, the wrapping is heated sufficiently to free gases to the required amount. It is for this purpose convenient to let the screen of bronze painting *s* extend just a little below the wrapping, so that the spark may be observed. There are, however, many other ways of overcoming this difficulty, which may cause some annoyance to those working with inadequate apparatus.

In order to insure the best action the experimenter should note the various stages which I have pointed out before, and through which the bulb has to pass during the process of exhaustion. He will first observe that when the Crookes phenomena show themselves most prominently there is a reddish streamer issuing from the electrode, which in the beginning covers the latter almost entirely. Up to this point the bulb practically does not affect the sensitive plate, although the glass is very hot at the point of impact. Gradually the reddish streamer disappears, and just before it ceases to be visible the bulb begins to show better action, but still the effect upon the plate is very weak. Presently a white or even bluish stream is observed, and after some time the glass on the bottom of the bulb gets a glossy appearance. The heat is still more intense and the phosphorescence through the entire bulb is extremely brilliant. One should think that such a bulb must be effective, but appearances are often deceitful, and the beautiful bulb still does not work. Even when the white or bluish stream ceases, and the glass on the bottom is so hot as to be nearly melting, the effect on the plate is very weak. But at this stage there appears suddenly at the bottom of the tube a star-shaped changing design, as if the electrode would throw off drops of liquid. From this moment on the power of the bulb is tenfold, and at this stage it must always be kept to give the best results.

I may remark, however, that while it may be generally stated the Crookes vacuum is not high enough for the production of the Roentgen phenomena, this is not literally true. Nor are the Crookes phenomena produced at a particular degree of exhaustion, but manifest themselves even with poor vacua, provided the potential is high enough. This is likewise true of the Roentgen effects. Naturally, to verify this, provision must be made not to overheat the bulb when the potential is raised.

(Concluded on page 174.)

ROENTGEN RAYS.

A LECTURE DELIVERED BEFORE THE NEW YORK ELECTRICAL SOCIETY, THURSDAY, MARCH 19, 1896, BY MAX OSTERBERG, E. E., A. M.

It gives me great pleasure, and I consider it an honor, to address you to-night on a subject which has attracted such wide attention throughout the civilized world.

But timely as the subject may be, it is rather difficult to lecture on it, inasmuch as probably every one of you has for weeks past followed the subject with keen interest in the daily as well as in the technical press. Permit me to assume, however, that many of you have arrived at the same stage as I had, a few weeks ago, when I was honored with a request to address you this evening. In preparing a short outline of what I wanted to present, I came to the conclusion that, filled with the many correct and incorrect statements, with the many experiments on Roentgen rays recorded, with the many theories advanced and contradicted, my mind was in about the same condition as the Broadway telegraph, telephone, electric light and power circuits some six years ago. I consequently went to work to sift out the essential points in connection with Roentgen's new discovery, and with your kind permission will give you an outline of where we appear to stand at the present time.

In order to have a clue to what the Roentgen rays are, and to the manner in which they were discovered, it is absolutely essential to burden you with some historical remarks which, as usual, find their beginning with Faraday, "the most useful and the most noble type of a scientific man," as Maxwell said, and about whom he made the following statement many years ago: "We are probably ignorant even of the name of the science which will be developed out of the materials we are now collecting when the great philosopher next after Faraday makes his appearance."

In his experimental researches, Faraday, as far back as 1838, made a statement which would be worthy of the noblest mind to-day, in the light of all the knowledge and experience gained during the past 58 years. Permit me, gentlemen, to read you this short section which is best given in our master's own words.

The action or effect which may be expressed by the general term discharge may take place, as far as we are aware, at the present time in several modes. Thus, that which is called simply conduction, involves no chemical action and apparently no displacement of the particles concerned; a second mode may be called electrolytic discharge; in it chemical action does occur, and particles must to a certain degree be displaced. A third mode, namely, that by sparks, or brushes, may, because of its violent displacement of the particles of the dielectric in its course, be called a disruptive discharge; and a fourth may, perhaps, be conveniently distinguished for a time by the words convection or carrying discharge, being that in which discharge is effected either by the carrying power of solid particles or those of gases and liquids. Hereafter, perhaps, all these modes may appear as the result of one common principle, but at present they require to be considered apart.

The displacement current of Maxwell certainly puts the three first classes into one category, and in consequence of Professor Roentgen's discovery it will probably not be long before our leading scientists can account for the convection currents in the same manner.

At present, however, the ideas diverge and we have to consider the theories advanced separately. Of that, however, later. After Faraday and Maxwell, both sons of Great Britain, Heinrich Rudolf Hertz, at the time professor at the University at Bonn, was to continue the work. He, too, has achieved some wonderful results, different entirely from the philosopher Faraday and the mathematician Maxwell. He performed the most convincing proof for the Faraday and Maxwell theories by furnishing actual experiments. But the work of Hertz extended in a still different direction. He was not only a scholar, not only an experimentalist, but he was also a master in teaching, a man so full of sincerity, so full of modesty and inspiration, that ever so many young, active men took his advice and suggestions, and helped by his knowledge and inspiration they, too, have become creative, and thus, like healthy seed, has his good influence scattered over several countries, and has interested such men as Lenard and Roentgen in the fruitful line of research, which he was pursuing up to the time of his sad death. We have now traced the line of scientists whose names are so honorably connected with the scientific developments of our century. Before taking up the work proper, we must call attention to several not less worthy members of the scientific profession, who, on account of the intricate nature of their researches, could not subject them to mathematical analysis. They are researches of which Maxwell says that they are exceedingly important, and when they are better understood they will probably throw great light on the nature of electricity as well as on the nature of gases and of the medium pervading space. I am referring to vacuum tubes or Glittorf and Crookes tubes in particular. These tubes are simply highly exhausted glass tubes with metallic inlets at at least two places. The metal pieces are called electrodes and are again separated into the anode and the cathode. The anode is that electrode which is connected to the positive pole of a machine, the cathode the one connected to the negative pole. Under ordinary exhaustion we have the well-known pretty effects of the Geissler tube, which, however, are of no interest to us this evening. It is a highly exhausted tube in which apparently the properties are created which at present demand our attention. Wm. Crookes, in a lecture on radiant matter delivered to the British Association at Sheffield, August 22, 1879, propounded a new theory in which he announced to have discovered a fourth state of matter, thus dividing matter into solids, liquids, gases and "radiant matter." He claimed to have observed that state only in very high vacua and he succeeded to exhaust a tube so that the air inside corresponded to a pressure of about the hundreth of an inch in a barometric column three miles high. It is not necessary at this stage to go into a discussion of this fourth state, and since it may easily meet with objections it might be as well for our purpose to simply say that some peculiar properties manifest themselves when we work with very high vacua, one of the principal phenomena being that the cathode or negative pole is the one which presents peculiarities; it appears to become the more important of the two poles and exhibits properties which are entirely distinct from those under ordinary conditions. Instead of saying that we are dealing with *radiant matter*, let us assume that we are simply dealing with rays which are generated at the cathode and are therefore called cathode rays. These cathode rays exhibit very remarkable properties, so for example do they leave the cathode in straight lines and normally to the surface at any point of the cathode, and entirely independent of the position and surface of the anode. They produce very strong phosphorescence of the glass, wherever they strike it, while the luminosity produced it but slight. They are deflected by a magnet, and assume in that case the shape of a parabola similar to the flight of a cannon ball under the influence of gravity. The cathode itself becomes very hot, and if it has the shape of a concave mirror the concentrated rays will develop heat in their focus.

Cummington in England succeeded to melt glass in this way and Crookes could even melt platinum. After a long time of discharge the inside walls of the globe or tube are covered with the material of the cathode, from which it follows that the rays *carry* material particles; but that does not by any means prove that the rays are due to material particles. These material particles are carried off, because the cathode becomes sufficiently hot to cause volatilization.

All these points have been verified years ago, and when Hertz commenced to work with vacuum tubes he was well aware of these properties. He added a valuable suggestion to the work which Philip Lenard, now professor at Breslau, but at that time *privat docent* at Bonn, carried out in a most conscientious and admirable manner. Hertz found that very thin filaments of gold leaf were transparent to cathode rays, for he succeeded to make glass phosphoresce when separated from the cathode by means of a gold leaf. Lenard then made the next step. He suggested of investigating whether phosphorescence could be possibly observed outside of the glass tube, and for that reason he sealed a piece of aluminum to one terminal of a glass cylinder, forming what he called an aluminum window. He actually observed phosphorescence outside of the aluminum window, but he could affect a plate only through a distance of six centimetres. He was positive that he had nothing but cathode rays, for he could deflect them by a magnet, just as he could those inside of the glass tube. If he rarefied the air outside of the aluminum window he could easily increase the distance through which fluorescent plates could be affected. Lenard made use of this observation to draw the very interesting conclusion that cathode rays are not due to radiant matter or Crookes's fourth state, but that it was a property of the ether, a view which had been held by several German physicists without the support, however, of any experiments. Lenard did a great deal more and valuable work. He determined that the absorption of the rays which he observed were, for example, proportional to the density through which they were passing. He showed that, by compressing hydrogen until it had the same density as oxygen, the absorption of both would be the same; but (and here comes one of the most essential points to be considered) he was not aware that he had any other but cathode rays. I actually regret to be forced to make this statement, but in these times, where scientists put their greatest aim to achieve privileges of priority, they must also be willing to accept a reproach for work which does not directly help to advance.

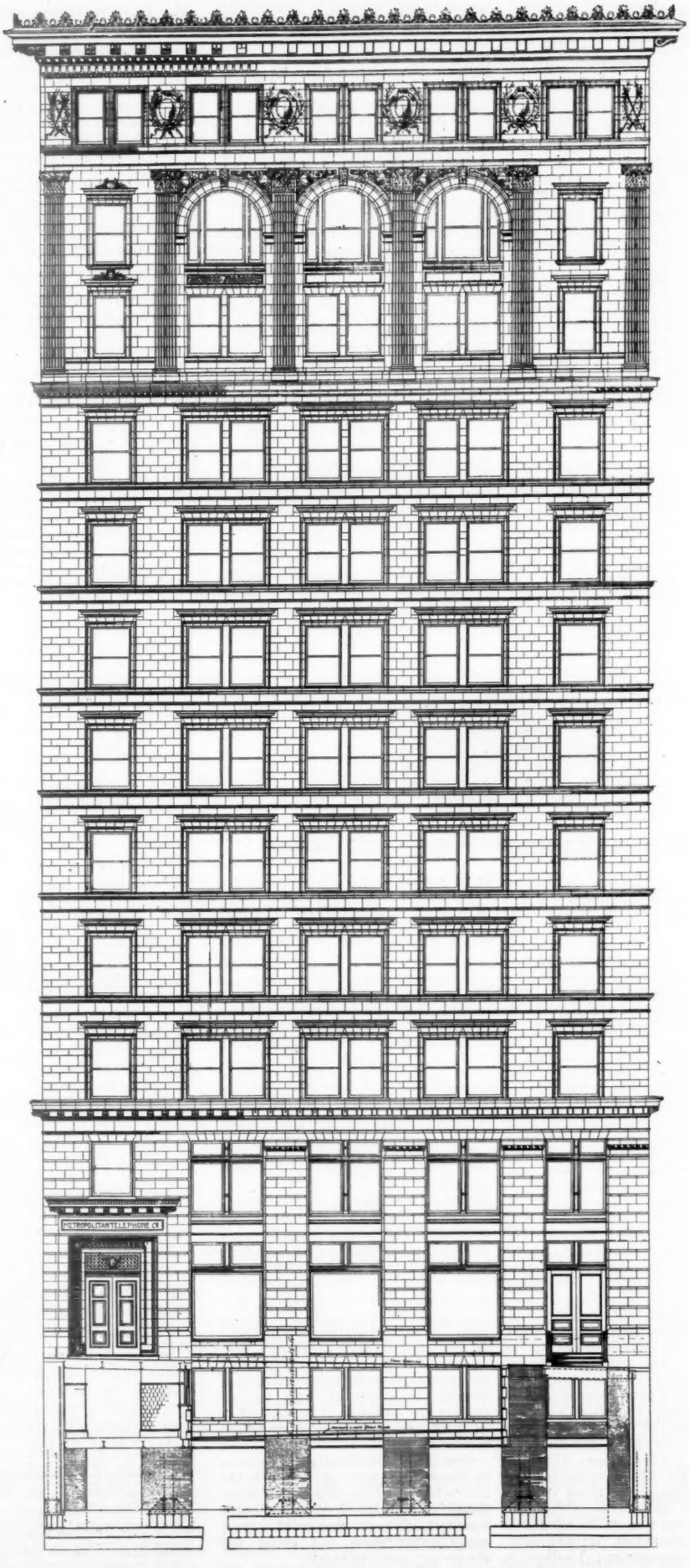
Lenard's position with respect to Roentgen's is about the same as Galvam's was with respect to Volta's. Although we admit that Galvam has started the work, we must also admit that it might have slumbered for years and years, if it had not been for Volta, for the simple and only reason that Galvam ascribed his phenomena to a wrong cause. Lenard mistook the rays which he observed for cathode rays pure and simple, but he was not aware of this new ray, with new properties, and possibly with a key to the most obscure chambers of science.

Thus we have arrived at the essential point of the lecture—at the question, what is the Roentgen rays? I may be pardoned, I trust, for not using the term X ray, the word used by Professor Roentgen in his now celebrated lecture, but he availed himself of this term only to distinguish it from the light rays about which he spoke, and probably also to allude to the undetermined nature of the same. To make an attempt to explain the nature of the Roentgen ray, and then to state its manner of manifestation, would be working against the natural law of historical development which I have tried to follow to the present. We will, therefore, take up its characteristics. In order to present the subject to you in as clear a manner as possible, let us compare the properties of the Roentgen rays, whenever possible, with the cathode and Lenard rays, for then wherever a new feature is introduced we can more intelligently appreciate it. Any highly exhausted tube through which the electrical discharge takes place may be covered with a piece of black paper or thin cardboard, and it will be observed in a perfectly dark room that a fluorescent screen, that is, any surface which has been coated or washed with barium platino cyanide, for example, will light up brilliantly and fluoresce equally well, whether the treated side or the other be turned towards the apparatus. This fluorescence is observable through a distance of two metres. Thus we have a phenomenon here which shows that phosphorescence can be observed through one piece of glass, that glass, however, being the surface of the Crookes tube and one or two pieces of cardboard. Lenard only found fluorescence in the direction of the aluminum window; Roentgen observed his effect for a distance of two metres; Lenard only through a distance of six centimetres.

Professor Roentgen tried to deflect the new rays by means of a magnet, as Lenard deflected the cathode rays, but he found it impossible to do so. This introduces an essentially new property—one of the utmost importance.

An attempt to deflect the cathode rays in the tube, which produced the phosphorescence on the surface of the glass, showed that in this case the direction of the Roentgen ray would be changed, but only inasmuch as it went forth in straight lines from the spot in which the cathode rays were concentrated. This led Professor Roentgen to the conclusion that the new ray was generated on the surface of the glass by the cathode, but shortly afterwards he found that an aluminum cylinder, excited by means of the discharge apparatus, will also excite the Roentgen ray. This would lead one to the conclusion that there are no Roentgen rays in a Crookes tube, and Prof. J. J. Thomson, in England, made an experiment to prove the correctness of this assertion, which was generally accepted, not only as extremely ingenuous, but also as conclusive. To this, however, I can not agree. Ingenuous as it appears, it has no practical value, for the negative result which is obtained is not by any means a proof of the non-existence of the rays inside of a vacuum.

(To be concluded.)



FRONT ELEVATION OF THE NEW BUILDING NOW BEING ERECTED BY THE METROPOLITAN TELEPHONE AND TELEGRAPH COMPANY, AT 13, 15 AND 17 DEY STREET, NEW YORK CITY.

The Metropolitan Telephone & Telegraph Company's New Building.

The growth of the business of the Metropolitan Telephone and Telegraph Company, of New York city, has been so rapid during the last few years that it has had great difficulty in securing sufficient office accommodation for its large and ever-growing force of officers and employés. For some time past the company has been compelled to occupy every available office in its large building at 18 Cortlandt street, and of late it has been necessary to secure offices in some of the other buildings in the vicinity.

The company has just commenced the erection of a fine modern building, at 13, 15 and 17 Dey street, which property is located just in the rear of the Cortlandt street building. An illustration of the front of this new building is presented herewith. Work has already been commenced on it, and it is expected that the building, will cost about $400,000 when completed. The contractors and builders have agreed to have the building finished by January 1, 1897. Mr. C. L. W. Eidlitz, of New York city, is the architect.

The building will be fireproof, of steel and terra-cotta construction, and will be 12 stories in height. The walls will be of such a thickness that at any future time four more stories may be added if necessary. The building will be equipped with electric elevators and electric lights, and the stairways will be trimmed with vermilion marble. There will be a corridor connecting the street floors of the present Cortlandt street building and the new building. There will also be connections between the two buildings at every floor. The new building will be occupied by the telephone company's offices, with the exception of the stores facing on the street, which will be rented for other purposes. It is expected that the long-distance office of the American Telephone and Telegraph Company will be removed from the Cortlandt street building to the Dey street building. The exchange of the Metropolitan Telephone and Telegraph Company will remain in the Cortlandt street building.

National Electric Light Association.

TO THE EDITOR OF ELECTRICAL REVIEW:

I am pleased to inform you that the Central Passenger Committee have granted the rate of a fare and one-third, on the certificate plan, from points in their territory to New York and return, for delegates attending the nineteenth convention of this association.

Mr. W. A. Kreidler, of the *Western Electrician*, Chicago; Messrs. Bryan & Humphrey, Turner Building, St. Louis, and Mr. E. H. Heinrichs, of the Westinghouse Electric and Manufacturing Company, Pittsburgh, will have charge of transportation matters in their respective localities.

A special party is being organized in Chicago, which will be joined *en route* by delegates along the line. A very large attendance is anticipated.

Very truly yours,

C. O. BAKER, JR.,

Master of Transportation.

New York, March 25, 1896.

TESLA ON REFLECTED ROENTGEN RAYS.

(*Concluded from page 171.*)

This is easily done by reducing the number of impulses or their duration, when raising the potential. For such experiments, it will be found of advantage to use in connection with the ordinary induction coil a rotating commutator, instead of a vibrating brake. By changing the speed of the commutator, and also regulating the duration of contact, one is enabled to adjust the conditions to suit the degree of vacuum and potential employed.

In my experiments on reflection, presently considered, I have used the apparatus shown in Fig. 2. It consists of a T-shaped box throughout, of a square cross-section. The walls are made of lead over one-eighth of an inch thick, which, under the conditions of the experiments, was found to be entirely impervious, even by long exposures to the rays. On the top end was supported firmly the bulb b, inclosed in a glass tube t of thick Bohemian glass, which reached some distance into the lead box. The lower end of the box was tightly closed by a plate-holder P_1, containing the sensitive film p_1, protected as usual. Finally the side end was closed by a similar plate-holder P, with the sensitive protected film p. To obtain sharp images the objects o and o_1, exactly alike, were placed in the center of the fiber cover, protecting the sensitive plates. In the central portion of the box, provision was made for inserting a plate r of material, the reflective power of which was to be tested, and the dimensions of the box were such that the reflected ray and the direct one had to go through the same distance, the reflecting plate being at an angle of 45 degrees to the incident as well as reflected ray. Care was taken to exclude all possibility of action upon the plate p, except by reflected rays, and the reflecting plate r was made to fit tight all around in the lead box, so that no rays could reach the film p_1, except by passing through the plate to be tested. In my earliest experiments on reflection I observed only the effects of reflected rays, but in this instance, on the suggestion of Prof. Wm. A. Anthony, I provided the above means for simultaneously examining the action of the direct rays, which eventually passed through the reflecting plate. In this manner it was possible to compare the amount of the transmitted and reflected radiation. The glass tube t surrounding the bulb b served to render the stream parallel and more intense. By taking impressions at various distances I found that through a considerable distance there was but little spreading of the bundle of rays or stream of particles.

To reduce the error which is caused unavoidably by too long exposures and very small distances, I reduced the exposure to an hour, and the total distance through which the rays had to pass before reaching the sensitive plates was 20 inches, the distance from the bottom of the bulb to the reflecting plate being 13 inches.

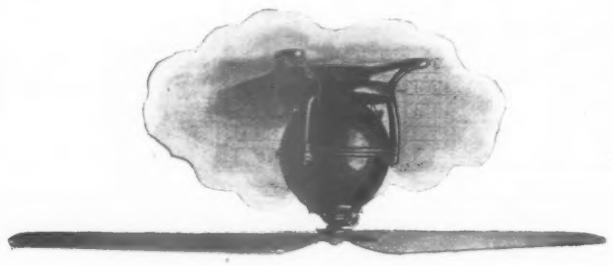
It is needless to remark that all the precautions in regard to the sensitive plates—constancy of potential, uniform working of the bulbs, and maintenance of the same conditions in general during these tests have been taken, as far as it was practicable. The plates to be tested were made of uniform size, so as to fit the space provided in the lead box. Of the conductors the following were tested: Brass, toolsteel, zinc, aluminum, copper, lead, silver, tin, and nickel, and of the insulators, lead-glass, ebonite, and mica. The summary of the observations is given in the following table:

Reflecting body.	Impression by transmitted rays.	Impression by reflected rays.
Brass.	Strong.	Fairly strong.
Toolsteel.	Barely perceptible.	Very feeble.
Zinc.	None.	Very strong.
Aluminum.	Very strong.	None.
Copper.	None.	Fairly strong, but much less than zinc.
Lead.	None.	Very strong, but a little weaker than zinc.
Silver.	Strong, a thin plate being used.	Weaker than copper.
Tin.	None.	Very strong; about like lead.
Nickel.	None.	About like copper.
Lead-glass.	Very strong.	Feeble.
Mica.	Very strong.	Very strong; about like lead.
Ebonite.	Strong.	About like copper.

By comparing, as in previous experiments, the intensity of the impression by reflected rays with an equivalent impression due to a direct exposure of the same bulb and at the same distance—that is, by calculating from the times of exposure under assumption that the action upon the plate was proportionate to the time—the following approximate results were obtained:

Reflecting body.	Impression by direct action.	Impression by reflected rays.
Brass	100	3
Toolsteel	100	0.5
Zinc	100	3
Aluminum	100	0
Copper	100	2
Lead	100	2.5
Silver	100	1.75
Tin	100	2.5
Nickel	100	2
Lead-glass	100	1
Mica	100	2.5
Ebonite	100	2

While these figures can be but rough approximations, there is, nevertheless, a fair probability that they are correct, in so far as the relative values of the impressions by reflected rays for the various bodies are concerned. Arranging the metals according to these values, and leaving for the moment the alloys or impure bodies out of question, we arrive at the following order: Zinc, lead, tin, copper, silver. The tin appears to reflect fully as well as lead, but, allowing for an error in the observation, we may assume that it reflects less, and in this case we find that this order is precisely the contact series of metals in air. If this proves true we shall be confronted with the most extraordinary fact. Why is zinc, for instance, the best reflector among the metals tested and why, at the same time, is it one of the foremost in the contact series? I have not as yet tried magnesium. The truth is that I was somewhat excited over these results. Magnesium should be even a better reflector than zinc, and sodium still better than magnesium. How can this singular relationship be explained? The only possible explanation seems to me at present that the bulb throws out streams of matter in some primary condition, and that the reflection of these streams is dependent upon some fundamental and electrical property of the metals. This would seem to lead to the inference that these streams must be of uniform electrification; that is, that they must be anodic or cathodic in character, but not both. Since the announcement, I believe in France for the first time, that the streams are anodic, I have investigated the subject and find that I can not agree with this contention. On the contrary, I find that anodic and cathodic streams both affect the plate, and, furthermore, I have been led to the conviction that the phosphorescence of the glass has nothing whatever to do with the photographic impressions. An obvious proof is that such impressions are produced with aluminum vessels when there is no phosphorescence, and, as regards the anodic or cathodic character, the simple fact that we can produce impressions by a luminous discharge excited by induction of a closed vessel, when there is neither anode nor cathode, would seem to dispose effectually of the assumption that the streams are issuing solely from one of the electrodes. It may, perhaps, be useful to point out here a simple fact in relation to the induction coils, which may lead an experimenter into an error. When a vacuum tube is attached to the terminals of an induction coil, both of the terminals are acted upon alike as long as the tube is not very highly exhausted. At a high degree of exhaustion both the electrodes act practically independently, and since they behave as bodies possessing considerable capacity, the consequence is that the coil is unbalanced. If the cathode, for instance, is very large, the pressure on the anode may rise considerably, and if the latter is made smaller, as is frequently the case, the electric density may be many times that on the cathode. It results from this that the anode gets very hot, while the cathode may be cool. Quite the opposite occurs if both of them are made exactly alike. But assuming the above conditions to exist, the hotter anode emits a more intense stream than the cool cathode, since the velocity of the particles is dependent on the electrical density, and likewise on the temperature.



THE LUNDELL "WHITE WINGS" ELECTRIC FAN.

From the previous tests an interesting observation can also be made in regard to the opacity. For instance, a brass plate one-sixteenth inch thick proved fairly transparent, while plates of zinc and copper of the same thickness showed themselves to be entirely opaque.

Since I have investigated reflection and arrived to results in this direction, I have been able to produce stronger effects by employing proper reflectors. By surrounding a bulb with a very thick glass tube the effect may be augmented very considerably. The employment of a zinc reflector in one instance showed an increase of about 40 per cent in the impression produced. I attach great practical value to the employment of proper reflectors, because by means of them we can employ any quantity of bulbs, and so produce any intensity of radiation required.

One disappointment in the course of these investigations has been the entire failure of my efforts to demonstrate refraction. I have employed lenses of all kinds and tried a great many experiments, but could not obtain any positive result.

NIKOLA TESLA.

New York, March 30.

Lundell Fan Motors.

The Interior Conduit and Insulation Company, of New York city, have issued a handsome and complete catalogue, showing their line of Lundell fan motors for the season of 1896. These machines—some 20,000 of which are now in actual use—are so well known throughout the country that a description of them is entirely superfluous. Special mention, however, should be made of several new styles which are now offered for the first time. The Lundell "White Wings," illustrated herewith, is a decided novelty. This is a ceiling fan motor with aluminum blades, made in two sizes, and especially adaptable for low-studded ceilings. The outfits are complete and most efficient, of handsome design, and are claimed to be the lowest-priced ceiling fan motors on the market.

The National Electrical Exposition.

As the time approaches for the opening of the National Electrical Exposition, in New York city, contracts for space are being closed more rapidly. In addition to the partial list of exhibitors published below, there is another list, nearly as large, of exhibitors who have reserved space, but whose contracts are not actually signed. The list of exhibitors who have signed contracts is as follows:

Abendroth & Root Co., New York.
Adams-Bagnall Electric Co., Cleveland, Ohio.
American Carbon Co., Noblesville, Ind.
American Stoker Co., Dayton, Ohio.
Babcock & Wilcox Co., New York.
Ball & Wood Co., New York.
Bishop Gutta-Percha Co., New York.
Birdsall Electric Mfg. Co., New York city.
Bryant Electric Co., Bridgeport, Ct.
Brady, T. H., New Britain, Ct.
Bradford Belting Co., Cincinnati, Ohio.
Bryan-Marsh Electric Co., New York.
Bossert, Wm. F., New York.
Burry, John, New York.
Carpenter Enamel Rheostat Co., Hoboken, N. J.
Calculagraph Co., New York.
Clark Electric Co., New York.
Columbia Incandescent Lamp Co., St. Louis, Mo.
Corey, R. B., New York.
Chapin-Douglass Electric Co., New York.
Cutter Electrical Mfg. Co., Philadelphia, Pa.
Crocker-Wheeler Electric Co., New York.
Columbia Rubber Works Co., New York.
Crouse-Tremaine Carbon Co., Fostoria, Ohio.
Crane Co., New York.
Diehl Mfg. Co., Elizabethport, N. J.
Dale, Farrell & Co., New York.
Eddy Electric Mfg. Co., Windsor, Ct.
Edison Electric Ill'g Co., New York.
Electrical Engineer, New York.
Electricity Newspaper Co., New York.
Forest City Electric Co., Cleveland, Ohio.
Ferracute Machine Co., Bridgeton, N. J.
Fuel Economizer Co., Matteawan, N. Y.
Goubert Manufacturing Co., The, New York.
General Electric Co., Schenectady, N. Y.
Gordon-Burnham Battery Co., New York.
General Incandescent Arc Lamp Co., New York.
Harrisburg Foundry and Machine Co., Harrisburg, Pa.
Huebel & Manger, Brooklyn, N. Y.
Holtzer-Cabot Electric Co., Boston, Mass.
Heine Safety Boiler Co., St. Louis, Mo.
Hunt, C. W., New York.
Ironclad Rheostat Co., Westfield, N. J.
India Rubber and Gutta-Percha Insulating Co., Yonkers, N. Y.
Jewell Belting Co., Hartford, Ct.
Johnston, The W. J., Co., New York.
Keasbey, R. A., New York.
Kennedy Valve Co., New York.
Keuffel & Esser Co., New York.
Lozier, R. T., New York.
Locke Regulator Co., New York.
Mica Insulator Co., New York.
McEwen, J. H., Manufacturing Co., Ridgeway, Pa.
Niles Tool Works Co., Hamilton, Ohio.
National Carbon Co., Cleveland, Ohio.
National Conduit Manufacturing Co., New York.
Nowotney Electric Co., Cincinnati, Ohio.
Nuttall, R. D., Co., Allegheny, Pa.
Okonite Co., New York.
Phœnix Iron Works, Meadville, Pa.
Peck Electrical Co., New York.
Partrick & Carter Co., Philadelphia, Pa.
Peru Electric Manufacturing Co., Peru, Ind.
Payne, W. B., & Sons, Elmira, N. Y.
Reisinger, Hugo, New York.
Riker Electric Motor Co., Brooklyn, N. Y.
Roebling's Sons, John A., Co., New York.
Stirling Co., The, Chicago, Ill.
Schieren, Chas. A., & Co., New York.
Siemens & Halske Electric Co. of America, Chicago, Ill.
Sunbeam Incandescent Lamp Co., Chicago, Ill.
Straight-Line Engine Co., Syracuse, N. Y.
Standard Electrical Lamp and Novelty Co., New York.
Standard Paint Co., New York.
Standard Underground Cable Co., Pittsburgh, Pa.
Shultz Belting Co., St. Louis, Mo.
Stanley Electrical Mfg. Co., Pittsfield, Mass.
Safety Insulated Wire and Cable Co., New York.
Stanley & Patterson, New York.
Schoonmaker, A. V., New York.
Smeltzer & Co., Nürnberg, Bavaria.
Tucker Electrical Construction Co., New York.
United Electric Improvement Co., Philadelphia, Pa.
United States Mineral Wool Co., New York.
Vacuum Oil Co., New York.
Vetter, J. C., & Co., New York.
Walker Manufacturing Co., Cleveland, Ohio.
Warren, A. K., & Co., New York.
Wagner Electrical Mfg. Co., St. Louis, Mo.
Weston Engine Co., Painted Post, N. Y.
Weston Electrical Instrument Co., Newark, N. J.
Williamsport Wooden Pipe Co., Williamsport, Pa.
Worthington, Henry R., New York.
Wilkinson Manufacturing Co., Bridgeport, Pa.

ADVANCE INFORMATION

Valuable News and Tips for Manufacturers and Dealers.

We publish below information relating to new electric railways, new electric light companies, new telephone companies and projected electric construction of all kinds. Every reader will find these columns of special interest, and manufacturers and supply houses will receive many valuable suggestions looking to new business by carefully watching this department in the ELECTRICAL REVIEW.

New Electric Railways.

SAN DIEGO, CAL.—The San Diego Cable Railway has been sold for $55,000 to Col. W. H. Holabird, and it will be changed into an electric system.

ELKTON, MD.—The Cherry Hill, Elkton & Chesapeake City Electric Railway Company, incorporated by J. C. Price, R. A. Duhamell, John Banks, T. Taylor Reynolds, C. H. Smith, Manly Drennan, Dr. Frank H. Mackie, George S. Woolley, William J. Smith, to build an electric line between Cherry Hill and Chesapeake City.

OXFORD, N. Y.—A. D. Harrington is interested in the construction of a $.00,000 electric railway to Norwich.

HAGERSTOWN, MD.—The Hagerstown Railway Company, of Washington County, has been incorporated by John A. Herman, William Jennings, Christian W. Lynch, of Harrisburg, and Justice J. I. Bitner, Albert J. Everley, John Blake and McKinley Embrey, Hagerstown. Capital stock, $200,000. Lyman D. Gilbert, John A. Herman, William Jennings and Christian W. Lynch, of Harrisburg, have been granted a franchise for an electric street railway, to be built in Washington, Potomac, Antietam and Mulberry streets and Broadway, Hagerstown, with extension to Williamsport, Funkstown and other nearby towns.

SAN FRANCISCO, CAL.—The San Francisco & San Mateo electric road is being offered for sale.

WATERLOO, IOWA — An electric line is to be constructed to connect with Cedar Falls. L. S. Cass and others are interested.

ALBANY, N. Y.-The Albany, Schoharie & Hedelberg Railroad Company has been granted permission to build an electric railway from Albany over the mountains.

WAYNE, MICH.—The Wayne Electric Road Company has been granted right of way through the corporation.

PALMYRA, N. Y. — An electric road is to be constructed between Palmyra and Marion.

FERNDALE, CAL.—F. Nelson, proprietor of the electric light works which are soon to be established, says that an electric railway will be built this Summer between Fort Kenyon and Fortune, if the necessary franchises, etc., can be secured.

CHATTANOOGA, TENN.—S. W. Divine is at the head of the company that has applied for franchise to build an electric railway. It is expected that the road will be built and in operation within 12 months.

DENVER, COLO.—West Creek Electric and Toll Road Company has been incorporated by B. B. Clawson, Arthur O. Williams and Sidney Williams. Capital stock, $100,000.

FITCHBURG, MASS.—M. A. Coolidge, of this city, has the contract for building and equipping the Hanover, Mass., street railway. This new line will connect with the Brockton street railway, Rockland & Abington and Hingham street railways, making a through electric line to Nantasket Beach.

CHICAGO, ILL.—The North Chicago Electric Railway Company will build a line on North Robey street from the intersection of Lincoln and Graceland avenues to Rose Hill Cemetery. Work on this line will be begun as soon as the weather will permit operations.

LA PORTE, IND.—The statement is made here that a syndicate composed of New York and Cleveland capitalists is behind a project to build a system of interurban electric lines in Northern Indiana, connecting various cities and towns.

CLEVELAND, OHIO—During the next few months some extensive improvements will be made by the street railroads here. Probably $400,000 will be spent in improvements, new tracks and new cars.

AKRON, OHIO—There is talk of the extension of the Akron & Cuyahoga Falls Rapid Transit Company to Cleveland.

OAKLAND, CAL.—F. M. Smith is said to be negotiating for the purchase of the Highland Park electric road, which is now in the hands of a receiver.

WORCESTER, MASS.—An effort is being successfully made by I. L. Currier, of this place, to organize a stock company to build an electric road from Ware to Warren.

BOSTON, MASS.—The Norfolk Centre Street Railway has received franchises from the towns of Dedham, Norwood and Walpole. The new road will be built this Summer, and will connect at Dedham Centre with the West Roxbury & Roslindale Street Railway Company, which is to lay its tracks over Washington street to Dedham through the West Roxbury district.

BALTIMORE, MD.—The extension of the Belt Railroad's electric construction is to be begun in the near future.

BOSTON, MASS.—A franchise has been granted to the West Roxbury & Roslindale Company for a line from Washington street at Forest Hills through Roslindale to Germantown.

DAYTON, OHIO—The Dayton Traction Company executed a mortgage for $250,000 to the Pennsylvania Finance Company, of Philadelphia, for the completion of their interurban electric railroad between Dayton and Miamisburg, a distance of 12 miles. The work is to be completed and in running order by July 1, and the road will be continued to Cincinnati within two years.

WARREN, MASS.—The Slater Engine Company has contracted with the new electric railroad to furnish an engine, boilers and pumps for the new power house to be located at Brookfield.

Electric Light and Power.

MCKEESPORT, PA. — An electric light plant is to be established and the Controller will advertise for bids shortly.

GRASS VALLEY, CAL.—The Providence Mining Company are contemplating lighting their mines by electricity and are negotiating with the Electric Power Company.

MCKELUMNE HILL, CAL. — The Roanoke Mining Company will put in an electric plant.

SPOKANE, WASH.—The Northwest Milling and Power Company will utilize the pumping station of the waterworks as a power house for their new electric light plant.

ASHLAND, WIS.—Ashland Light, Power and Street Railway Company has been incorporated by Charles Quarles, R. C. Heydlauff and Adolph Kanneberg. Capital stock, $300,000.

OELLA, MD.—Wm. J. Dickey & Sons will put in an electric light plant in the near future.

NEW YORK, N. Y.—Morely Acetylene Gas Company has been incorporated by J. H. Morely, Springfield, Mass.; C. H. Reeve, A. S. Hall, E. F. Eldridge and N. S. Easton, of New York city. Capital stock, $500,000.

SAN MATEO, CAL.—Electric light plant is to be established in Court House.

SAN FRANCISCO, CAL.—Berkeley Electric Lighting Company stockholders have decided to issue $30,000 with which to enlarge plant.

SANTA CLARA, CAL.—C. E. Moore is preparing plans and specifications for the electric plant which is to be established.

NEW YORK, N. Y.—The Peruvian Consul in this city is inviting proposals until June 1 for an electric lighting franchise at Lima, Peru.

ALBANY, N. Y.—Proposals will be invited for lighting the city streets with electricity.

BOSTON, MASS.—The Boston Electric Light Company has petitioned to issue $200,000 in bonds for the purpose of putting its wires underground.

ORANGE, N. J.—The South Orange Light and Power Company has been incorporated by Henry A. Page, Edward D. Page, W. M. Haines and Frank Brewer, for the purpose of constructing electric light plant to do its own street lighting. Capital stock, $50,000.

MAPLETON, MINN.—C. H. Brown will establish an electric light plant, and has placed an order with the D. & D. Electric Manufacturing Company, of Minneapolis, for same.

SIDNEY, N. Y.—Onleout Electric Light and Power Company has been incorporated by H. McGonegal, James C. Holden, of New York city; Walter F. Randall, of Syracuse; Fred. C. Ward, of Franklin, and H. S. Sewell, of Walton, to operate in Sidney and Unadilla, Otsego County. Capital stock, $25,000.

HOMESTEAD, PA.—The Homestead Gas. Light and Fuel Company has been incorporated with a capital stock of $1,000.

CHICAGO, ILL. — Electricity will take the place of gas for street lighting in all the First Ward of Chicago.

INDIANAPOLIS, IND.—The Board of Works has asked the City Controller to recommend an additional appropriation of $2,000 for electric lights to take the place of the vapor lights which have been removed.

ATTICA, N. Y.—The property of the Attica Water and Gas Company has been purchased by the Maplewood Waterworks Company. The directors of the new company are Messrs. Augustine S. Smith, Burley Smith, Edward T. Gray, O. P. Stockwell and Edward Volkins, all of this place.

ROCHESTER, N. Y.—A proposition to utilize the Court House electric light plant for lighting the City Hall and Free Academy is being considered.

BERKELEY, CAL.—The stockholders of the Berkeley Electric Lighting Company decided this evening to issue bonds for $30,000 with which to enlarge its plant.

HAMBURG, IOWA—The Hamburg Electric Light Company has filed articles of incorporation. The authorized capital stock is $12,000. Incorporators, W. S. Staley, C. D. Butterfield, C. A. Buckmaster and H. T. Hays.

PORTSMOUTH, N. H.—Hon. Frank Jones will, as soon as Spring opens, build an electric light plant for the lighting of his suburban residence and grounds, the brewery plant, the Rockingham and Hotel Wentorth at New Castle, and will furnish power and light to any wishing to purchase the same. The building site for the plant was surveyed yesterday.

New Telephone and Telegraph Companies.

LE SUEUR, MINN.—H. E. Termath is organizing a stock company to build a telephone from here to Le Sueur Centre.

IRVINGTON, N. Y.—A franchise has been granted to the Westchester County Telephone Company for the purpose of erecting poles and stringing wires in the streets of that village.

YORK, PA.— Arrangements have been completed to extend the Delta Telephone system to Fawn Grove, and reaching various points in York and Harford counties.

BOSCAWEN, N. H.—A telephone line between this place and Shaker Village is to be constructed in the Spring.

MONTGOMERY, VT.—The Citizens' Telephone Company, of Enosburg Falls, has purchased the poles and wire of the so-called People's line in this county and will supply new and better instruments to customers, as well as extend the line to other towns and give the people telephone communications throughout the county, as well as in many towns across the border.

MILWAUKEE, WIS.—The Wisconsin Telephone Company has decided to establish a branch station on the west side, similar to the one now in operation on the south side. The new exchange will probably be in operation July 1.

BURLINGTON, VT.—A telephone line between this city and Hinesburgh is contemplated.

LA PROSSE, WIS.—The Wisconsin Telephone Company are about to put a new and improved switchboard in their exchange in this city. Other improvements are about to be made that will increase still further the efficiency of the service.

CASPER, COLO.—A telephone exchange is to be established here.

SAN FRANCISCO, CAL.—The Security Electrical Inspection Company has been incorporated by A. St. John Bowie, Oscar Blain, Joseph Napthaly, Alfred Bouvier, Samuel N. Napthaly, Thomas J. Craig and David Freidenrich. Capital stock, $100,000.

SAN FRANCISCO, CAL.—Sterling Electric Supply Company has been incorporated. Directors, John R. Cole, A. H. Pennoyer, F. G. Cartright, F. W. Gale and F. N. Delanoy. Capital stock, $100,000, of which $10,000 has been subscribed.

WHEELING, W. VA.—The Dillon, Wheat & Hancher Electric Company has been incorporated with an authorized capital stock of $25,000. The incorporators are I. G. Dillon, A. A. Wheat, C. N. Hancher, E. T. Albert and J. M. Weistling, all of Wheeling.

Business Troubles.

PITTSFIELD, MASS.—The S. K. C. Specialty Company, of Pittsfield, manufacturers of electrical novelties and small wares, have filed a petition in insolvency.

FALL RIVER, MASS.—William F. Tanner, dealer in bicycles and electrical supplies, went into insolvency last week. No statement of the assets or liabilities has yet been made.

BALTIMORE, MD.—A receiver for the Baltimore & Catosville Construction Company and the Columbia & Maryland Railroad Company has been asked for.

ST. PAUL, MINN. — F. Tenney, proprietor of the St. Paul Electric Plating Works, has made an assignment to R. J. Eggleton for the benefit of his creditors.

NEW YORK, N. Y.—The Complete Electric Construction Company, of 121 Liberty street, has gone into the hands of a receiver. Charles Haldane Johnson has been appointed.

Increase of Capital.

ALBANY, N. Y.—The Albany Street Railway Company has voted in favor of an increase of $500,000 in the capital stock. This will bring the authorized capital up to $2,000,000.

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On the Crest of the Alleghenies.

To those contemplating a trip to the mountains in search of health or pleasure, Deer Park, on the crest of the Allegheny Mountains, 3,000 feet above the sea level, offers such varied attractions as a delightful atmosphere during both day and night, pure water, smooth, winding roads through the mountains and valleys, and the most picturesque scenery in the Allegheny range. The hotel is equipped with all adjuncts conducive to the entertainment, pleasure and comfort of its guests.

There are also a number of furnished cottages with facilities for housekeeping.

The houses and grounds are supplied with absolutely pure water, piped from the celebrated "Boiling Spring," and are lighted with electricity. Deer Park is on the main line of the Baltimore & Ohio Railroad, and has the advantages of its splendid Vestibuled Limited Express trains between the East and West. Season excursion tickets, good for return passage until October 31, will be placed on sale at greatly reduced rates at all principal ticket offices throughout the country.

The season at Deer Park commences June 22, 1896.

For full information as to rates, rooms, etc., address George D. DeShields, Manager, Deer Park, Garrett County, Maryland.

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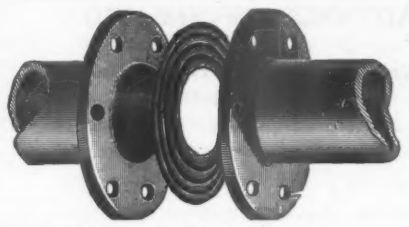

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New York Electric Company,

YOUNGSTOWN, OHIO.

THE MUTUAL LIFE INSURANCE CO.,

OF NEW YORK.

RICHARD A. McCURDY, President.

Assets, - - - - - $221,213,721 33.

This great company will hereafter extend the privilege of Life Insurance without extra charge to all Electrical Engineers of one or more years' experience.

By the above term it is intended to include all those who are in sole charge of dynamos, either afloat or ashore, and those who may occupy still higher and more responsible positions as electricians.

CAPTAIN H. R. FREEMAN, late of the Cromwell Steamship Line, Manager of this department, was instrumental in getting this Company to make the above concession in favor of Electrical Engineers. All electricians wishing insurance in the United States or Canada should make application in person or by letter to Capt. H. R. Freeman, or any authorized Maritime Agent, Mutual Life Building, No. 32 Liberty St., New York.

The Bishop Gutta-Percha Company, 420 to 426 East Twenty-fifth street, New York city, have issued a price-list of their gutta-percha specialties, such as acid vessels, acid jugs, bottles, funnels, pitchers, etc.

The Ellwell-Parker Electric Company, Cleveland, Ohio, manufacturers of motors, are constructing a new building for manufacturing purposes which they expect to have ready for occupancy within the next few months.

The Interior Conduit and Insulation Company, 527 West Thirty-fourth street, New York city, announce that their ventilating department is now under the charge of Mr. Wm. H. A. Davidson, formerly of the Davidson Ventilating Fan Company. Mr. Davidson has been identified with the ventilating fan interests for many years, having been one of the pioneers in the art of ventilation with disk fans, and is the inventor of the Davidson & Starbuck fans.

The Electric Appliance Company, of Chicago, is just distributing two catalogues which should be in the "catalogue library" of every electric light station in the country. One of these is their catalogue of Paiste specialties, and the other of P. & S. porcelain specialties. Both of these catalogues are supplied with special trade discount sheets giving the latest and lowest trade prices on these goods, and hence are valuable information to the close buyer. Copies may be had free on application.

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A Modern Electric Light and Power Plant

Consisting of six 100-horse-power McCormack Cylinder Gate Water-Wheels, set in six stone flumes, all in gilt-edged shape, with best of shafting, foundations, brick building, etc., all new. Two Russell Automatic Engines of 450 horse-power capacity, for use in case of emergencies. One 60-horse-power power generator, three alternating dynamos of 3,500 lights capacity and seven arc dynamos of 300 lights capacity. A five-year city street lighting contract, 100 lights; also excellent commercial patronage. Excellent water-power lease for thirty years at $10 per horse-power per year.

A snap for the right man; owners going away. Will bear closest investigation.

Location is a prosperous, manufacturing Indiana town of 15,000 people.

Address the owner, O. N. LUMBERT, Syracuse, N. Y.

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SEGMENTS and WASHERS.
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The Only Successful Commercial Light. Guaranteed Under All Conditions. Have Replaced All Other Makes.

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	Polished Slate Base.			
25	Ampere,	Single	Pole	$0 50
50	"	"	"	65
75	"	"	"	1 00
25	"	Double	"	60
50	"	"	"	1 10
75	"	"	"	1 50
25	"	Triple	"	1 25
50	"	"	"	1 75
75	"	"	"	2 00

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ELECTRICAL PATENTS

ISSUED MARCH 24, 1896.

556,763 Telephone switch; W. A. Moore, Brooklyn, N. Y.

556,769 Electrode for secondary batteries; O. Pirsch, Liege, Belgium.

556,782 Secondary battery; Max Sussmann, Neu-Ruppin, Germany.—Comprises a sheet metal conductive core and an active material consisting of a paste composed of a plumbic material and pumice stone in a finely divided state, and a solution of rubber.

556,788 Operating dynamo electric machines in multiple; E. Verstraete, St. Louis, Mo.—A generator having series field coils and field coils in shunt relation to the armature, another generator supplying the same circuit in multiple, having a set of shunt field coils energized by current taken from opposite sides of the armature of the first generator.

556,823 Automatic grounding device for electric conductors; G. A. Jewet, Chicago, Ill.

556,854 Conductor for electrical decomposing tanks; J. Leith, St. Helens, Eng.

556,862 Controller for electric motors; E. D. Priest, Schenectady, N. Y.—Comprises a reciprocating resistance switch, a separate reciprocating series parallel switch, and permanently connected means for operating the two switches.

556,864 Trolley support; E. B. Reichel, Germany.—Consists of yieldingly pressed levers pivoted to stationary supports, a pivoted trolley arm mounted upon the ends of said levers, and springs for imparting to said trolley arm a tendency to occupy a vertical position.

556,865 Alternating current system; E. W. Rice, Swampscott, Mass.—An electro-dynamic machine of the three-phase type having its different armature coils wound with wire of different sections corresponding to the strength of current they are designed to generate.

556,866 Electric elevator; E. W. Rice, Jr., Schenectady, N. Y.

556,870 Wire gauge for dynamos or motors; A. B. Soar, London, Eng.—An electrical contact or commutator brush comprising super-posed layers of corrugated wire gauge, the said layers being compressed together to constitute practically a solid brush.

556,876 Clip for trolley wires; R. H. Beach, East Orange, N. J.

556,882 Device for placing electric blasting fuses; R. H. Elliott, Birmingham, Ala.—An igniting device for use in blasting, consisting of an electric fuse, of flexible wires connected to said fuse and covered with flexible insulating material for a short distance from said fuse, and a rod made of insulating material and inclosing the portion of said wires adapted to lie in the borehole and terminating a short distance from the fuse.

556,891 Support for field magnet coils; B. G. Lamme, Pittsburgh, Pa.—A bracket or hanger for field magnet coils having outer coil-supporting flanges and intermediate flanges or fingers projecting from the main or body portion thereof and substantially at right angles thereto.

556,893 Electric car truck; E. Lundquist, Pittsburgh, Pa.

556,898 Electric arc lamp; G. C. Pyle, Indianapolis, Ind.—A lamp-post, a lever supported by such post and having on it a trough-shaped bracket and a holding-bar for the upper electrode, having a pin threon that fits in the bracket on the lever.

556,902 Electrical detonator; C. H. Rudd, Chicago, Ill.—Explosive material, fusible conductors for igniting said explosive material included in an electric circuit in series, and a shunt or by-path about each of said fusible conductors for carrying current to the conductors last to fuse.

556,903 556,904 Electrical detonator; C. H. Rudd, Chicago, Ill.

556,941 Trolley attachment for electric cars; F. S. Smith, Hartford, Ct.

556,945 Regulating device for controlling working of electromotors; Rene Thury, Geneva, Switzerland.

556,947 Electric signal lamp; A. F. Ward, Memphis, Tenn.—Comprises a dynamo, a hand-driven mechanism therefor, and an inclosing protective casing, in combination with a folding mast carried by said dynamo casing and a signal lamp at the upper end of the mast.

556,949 Safety device for electric cars; A. H. Wheeler, Warwick, R. I.

556,959 Means for attaching and detaching electric lamps; F. A. Butterfield, Detroit, Mich.—A device for attaching and detaching incandescent lamp bulbs, consisting of a conical casing having gripping material on its inner face, yielding jaws projecting over and above the upper end of the casing, and a handle at the opposite end of the casing.

556,967 Electrical connector; P. H. Fielding, New York, N. Y.—A connector designed for theater use, the plug being inserted in the floor pocket consisting of a tube of insulating material and provided with internal electrical contacts.

556,971 Insulated support for contact rails; A. Hanson, Chicago, Ill.

556,987 Electric recording instrument for ship's compasses and logs; C. L. Jaeger, Maywood, N. J.—A recording device comprising a conducting disk having projections, a conducting arm actuated through suitable mechanism and arranged to rotate close to the conducting disk, conductors for the disk and conducting arm, a source of electricity, an induction coil, a recording device and electrical connections.

557,008 Electric trolley; G. R. Mitchell, Newtown, Pa.

557,015 Trolley for electric railways; P. F. O'Shaughnessy, New York, N. Y.—A car, a trolley for making an underneath contact with a conductor, a telescopic support for said trolley on the roof of the car, and means extending within reach of the operator for adjusting said trolley.

557,037 Electrical connector; B. L. Yoquet, Westport, Ct.—A tube for a joint for electrical conductors indented to form an internal central stop or stops.

557,048 Zinc support for batteries; H. J. Brewer, New York, N. Y.—A zinc pencil, the battery jar having a lip, the projecting spout integral therewith, and the detachable zinc support having two downwardly-projecting arms engaging with the two sides of the spout of the jar.

557,049 Means for supporting motors and motor frames; E. S. Breed, New Britain, Ct.

557,057 Process of and apparatus for producing metallic compounds by electricity; E. N. Dickerson, New York, N. Y.

557,094 Converter of frequency for alternating electric currents; M. Hutin, Paris, France.—The method of transforming an alternating electric current of one periodicity into an alternating current of another periodicity, which consists in successively and continuously changing the points of line connection in either direction around a commutator apparatus.

American Institute of Electrical Engineers.

At the monthly meeting of council, held March 25, the returns of nominations were canvassed, and the following council nominees were selected: For president, Louis Duncan, of Baltimore; for vice-presidents, Chas. P. Steinmetz, of Schenectady, N. Y.; Harris J. Ryan, of Ithaca, N. Y., and W. M. Stine, of Chicago; for managers, J. W. Lieb, Jr., of New York city; F. A. Pickernell, of New York city; Wm. L. Puffer, of Boston, and L. B. Stillwell, of Pittsburgh; for treasurer, Geo. A. Hamilton, of New York city; for secretary, Ralph W. Pope, of New York city.

The terms of the following officers do not expire this year: Vice-presidents, Angus S. Hibbard, of Chicago; Dr. M. I. Pupin, of New York city, and W. F. C. Hasson, of San Francisco; managers, A. E. Kennelly, of Philadelphia; C. S. Bradley, of Baltimore; W. D. Weaver, of New York city; W. B. Vansize, of New York city; Chas. F. Scott, of Pittsburgh, Carl Hering, of Philadelphia; Cary T. Hutchinson, of New York city, and B. J. Arnold, of Chicago.

The rules have been amended by the council, under advice of the committee on incorporation, in order to conform with the laws of the State of New York. The rules will hereafter be known as the "constitution," and under its provisions the secretary is now elected by the institute at large instead of the council. The system of cumulative voting is abolished. Copies of the revised constitution will be mailed to the membership, with the ballots, on or before April 15.

Nineteen associate members were elected and 10 associate members were transferred to full membership.

At the meeting of the Institute in the evening a paper was presented by Prof. W. L. Puffer, of Boston, on "A New Method of Studying the Light of Alternating Arcs." Sixty members and visitors were present. After the reading of the paper, at 12 West Thirty-first street, the meeting adjourned to Columbia University, where the experiments referred to were very effectively shown on a screen.

PERSONAL.

William Stanley, Jr., of the Stanley Electrical Manufacturing Company, Pittsfield, Mass., visited New York city last week.

Prof. Edward Weston, of Newark, N. J., sailed for Bermuda last week. It is understood that he is suffering from overwork, and that this trip is made in the hope that he will regain his health.

Mr. L. J. Montgomery last week resigned the secretaryship of the Electricity Newspaper Company, of New York. It is Mr. Montgomery's intention to still remain identified with metropolitan journalism.

Mr. George Alexander McKinlock, president of the Central Electric Company, Chicago, made a flying visit to New York last week on business connected with the Interior Conduit and Okonite companies. Mr. McKinlock returned to the great West via the New York Central and Michigan Central railroads on Saturday.

Mr. H. G. Tuckerman, who for over four years past has been a valued member of the ELECTRICAL REVIEW staff, has resigned his position as Boston representative of this paper to accept a responsible position with a Wyoming gold mining company. During Mr. Tuckerman's connection with the ELECTRICAL REVIEW he has made a large number of friends who will join us in wishing him the utmost success and prosperity in his new field of labor.

INDUSTRIAL NOTES.

The Goodrich Hard Rubber Company, at Akron, Ohio, are satisfactorily demonstrating the fact to the electrical public that the city of Akron is blessed with at least one pretty girl. This practical demonstration is in the form of a very large colorotype of a girl whose profile is shown in a most striking attitude. The model from which this is made, the recipient of this picture is informed, graces the office of the Goodrich Hard Rubber Company, at Akron, Ohio.

The Card Electric Company, of Mansfield, Ohio, are now making for erection in the factory of the Cliff Paper Company, at Niagara Falls, two generators of 100 kilowatts, which are to be directly connected to turbines of 250 horse-power, manufactured by James Leffel & Company, of Springfield, Ohio. This introduction of electricity is an innovation in the manufacture of paper, and it is probable that this will prove a success, as the requirements of paper-making are essentially that of absolute regularity in power, which can be well attained by the use of electricity.

Fred M. Locke, of Victor, N. Y., has just issued an interesting catalogue for telephone, telegraph and electric light companies, illustrating his splendid line of high insulating line specialties. The demand for the triple china petticoat insulator which he manufactures has been so great that at the present time his product is many thousand short of the demand. This high-voltage insulator is four inches high and five and one-fourth inches in diameter, and its insulating strength has been tested up to 85,000 volts. Mr. Locke informs the editor of the ELECTRICAL REVIEW that he will be glad to send this pamphlet free of charge to applicants.

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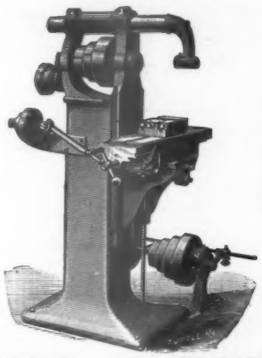

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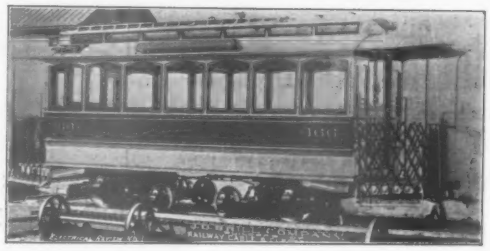

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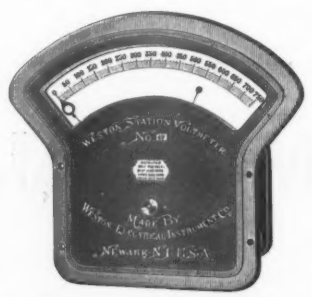

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